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THEORETICAL AND PRACTICAL

IN

TREATISES BY VARIOUS AUTHORS.

EDITED BY

T. HOLMES, M.A. CANTAB.

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MEMB. CORRESP. DE LA SOCIÉTÉ DE CHIRURGIE DE PARIS.

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By T. Holmes, Esq.

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INCLUDING

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By B. Brodhurst, Esq.

ORTHOPŒDIC-SURGEON TO ST. GEORGE'S HOSPITAL;

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By A. Shaw, Esq.

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PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL.

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BY T. HOLMES, ESQ.

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By Sir J. Ranald Martin, C.B., F.R.S.

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By Holmes Coote, Esq.

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NAMES.	SUBJECTS.
A. W. BARCLAY, Esq., M.D. Physician to St. George's Hospital.	Delirium Tremens, vol. i.; Diphtheria and Croup, vol. iv.
J. BIRKETT, Esq. Surgeon to Guy's Hospital.	Injuries of the Pelvis, vol. ii.; Hernia, vol. iv.; Diseases of the Breast, vol. v.
B. BRODHURST, Esq. Orthopœdic Surgeon to St. George's Hospital.	Congenital Dislocations and intra-uterine Fractures,* vol. v.
G. BUSK, Esq., F.R.S. Surgeon to the Seamen's Hospital-ship 'Dreadnought.'	Parasites, and the Diseases which they produce; Venomous Insects and Reptiles, vol. v.
C. E. BROWN-SÉQUARD, M.D., F.R.S.	The remoter consequences of Nerve-Lesions, vol. iv.
G. W. CALLENDER, Esq., F.R.S. Surgeon to St. Bartholomew's Hospital.	Pyæmia, vol. i.; Diseases of the Veins, vol. iii.
J. LOCKHART CLARKE, Esq., M.D., F.R.S.	Re-edition of Mr. Tatum's essay on Affections of the Muscular System, vol. iii.; Diseases and Injuries of the Nerves, Locomotor Ataxy, vol. iv.
HOLMES COOTE, Esq. Surgeon to St. Bartholomew's Hospital.	Abscess, Gangrene, vol. i.; Injuries of the Face, vol. ii.; Diseases of the Tongue, vol. iv.; Diseases of the Thyroid Gland, Plastic Surgery, Surgical Apparatus, vol. v.
J. CROFT, Esq. Assistant Surgeon to St. Thomas's Hospital.	Hectic and Traumatic Fever, vol. i.
C. DE MORGAN, Esq., F.R.S. Surgeon to the Middlesex Hospital.	Erysipelas, vol. i.
J. DIXON, Esq. Consulting Surgeon to the Royal London Ophthalmic Hospital.	Diseases and Injuries of the Eye, vol. iii.
A. E. DURHAM, Esq. Assistant Surgeon to Guy's Hospital.	Injuries of the Neck, vol. ii.; Diseases of the Nose, Diseases of the Larynx, vol. iv.
W. H. FLOWER, Esq., F.R.S. Conservator of the Museum of the Royal College of Surgeons.	Injuries of the Upper Extremity, vol.

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* Being a portion of the essay on the Surgery of Childhood.

NAMES.	SUBJECTS.
G. HARLEY, Esq., M.D., F.R.S. Physician to University College Hospital.	Apnœa, vol. v.
CHARLES HAWKINS, Esq. Inspector of Anatomy.	Lithotrity, vol. iv.
PRESCOTT HEWETT, Esq. Surgeon to St. George's Hospital.	Injuries of the Head, vol. ii.
T. HILLIER, Esq., M.D. Late Physician to the Hospital for Sick Children.	A portion of the essay on Diseases of the Skin, vol. v.
J. HINTON, Esq. Aural Surgeon to Guy's Hospital.	Diseases of the Ear, vol. iii.
T. HOLMES, Esq. Surgeon to St. George's Hospital. Editor.	Burns and Scalds, General Pathology of Dislocation, vol. ii. ; Aneurism, Diseases of the Bones, vol. iii.: Excision of Bones and Joints, Surgical Diseases of Childhood,* Surgical Diagnosis and Regional Surgery, vol. v.
C. HOLTHOUSE, Esq. Surgeon to the Westminster Hospital.	Injuries of the Lower Extremity, vol. ii.
T. K. KORNIDGE, Esq.	General Pathology of Fractures, vol. ii.
J. W. HULKE, Esq., F.R.S. Surgeon to the Middlesex Hospital.	Re-edition of Mr. Flower's essay on Injuries of the Upper Extremity, vol. ii.
G. M. HUMPHRY, Esq., M.D., F.R.S. Professor of Anatomy in the University of Cambridge.	Diseases of the Male Organs, vol. v.
JONATHAN HUTCHINSON, Esq. Surgeon to the London Hospital.	Surgical Diseases of Women, vol. v.
SIR W. JENNER, Bart., F.R.S. Physician in Ordinary to the Queen.	Diseases of the Skin, vol. v.† (a portion).
ATHOL A. W. JOHNSTONE, Esq.	Diseases of the Joints, vol. iv.
H. LEE, Esq. Surgeon to St. George's Hospital.	Syphilis, vol. i. ; Gonorrhœa, vol. v.
J. LISTER, Esq., F.R.S. Professor of Clinical Surgery in the University of Edinburgh.	Anæsthetics, Amputation, vol. v.
W. J. LITTLE, Esq., M.D.	Orthopœdic Surgery, vol. iii.
T. LONGMORE, Esq., C.B. Professor of Military Surgery in the Army Medical School, Netley.	Gunshot Wounds, vol. ii.
SIR J. RANALD MARTIN, C.B., F.R.S. Examining medical officer to the Secretary of State for India in Council.	Hospitals, vol. v.
C. H. MOORE, Esq. Late Surgeon to the Middlesex Hospital.	Tumours ‡ and Cancer, Wounds of Vessels, vol. i. ; Diseases of the Absorbents, Atheroma and Obstruction of the Arteries, vol. iii.

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* In conjunction with Mr. Brodhurst and Mr. Shaw.
† In conjunction with Mr. Nayler and the late Dr. Hillier.
‡ Re-edition of Mr. Paget's essay on this subject.

Names.	Subjects.
G. Nayler, Esq. Surgeon to the Hospital for Diseases of the Skin.	A portion of the essay on Diseases of the Skin, vol. v.
J. Paget, Esq., F.R.S. Consulting Surgeon to St. Bartholomew's Hospital	Sinus and Fistula, Ulcers, Contusions, Wounds, vol. i.
A. Poland, Esq. Surgeon to Guy's Hospital.	Tetanus, Animal Poisons, vol. i.; Injuries of the Chest, vol. ii.; Calculus, Lithotomy, vol. iv.
G. D. Pollock, Esq. Surgeon to St. George's Hospital.	Injuries of the Abdomen, vol. ii.; Diseases of the Mouth and Alimentary Canal, vol. iv.
S. James A. Salter, Esq., F.R.S. Dental Surgeon to Guy's Hospital.	Surgical Diseases connected with the Teeth, vol. iv.
J. Burdon Sanderson, Esq., M.D. F.R.S. Professor of Practical Physiology at University College, London.	The Process of Inflammation, vol. v.
W. S. Savory, Esq., F.R.S. Surgeon to St. Bartholomew's Hospital.	Scrofula, Hysteria, Collapse, vol. i.
A. Shaw, Esq. Consulting Surgeon to the Middlesex Hospital.	Injuries of the Back, vol. ii.; Disease of the Spine, vol. iv.; Lateral Curvature and Pigeon-breast Deformity,* vol. v.
J. Simon, Esq., F.R.S. Medical Officer of the Privy Council.	Inflammation, vol. i.†
H. Smith, Esq. Assistant Surgeon to King's College Hospital.	Diseases of the Rectum, vol. iv.
T. Smith, Esq. Surgeon to the Hospital for Sick Children. Assistant Surgeon to St. Bartholomew's Hospital.	Surgical Affections of the Skin and its Appendages, Minor Surgery, vol. v.
Sir H. Thompson Surgeon to University College Hospital.	Diseases of the Urinary Organs, vol. iv.

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* Being a portion of the essay on the Surgery of Childhood.

† Dr. Sanderson's essay in vol. v. forms a part of this.

NOTE BY THE EDITOR ON HIS ESSAY ON ANEURISM IN VOL. III.

I wish to point out in the above essay an error in the description of Fig. 163, p. 525, into which I was led by the absence of any reference or history in the catalogue of the Museum. The preparation is not by Mr. Liston, as I was informed, but by Sir C. Bell, and the case is related in his 'Practical Essays,' Part II., Edinb. 1842, p. 65. The ulnar artery is said, in Sir C. Bell's account of the case, to have been tied, as well as the radial, during the patient's life. Mortification of the arm ensued, of which the patient died. There had not been any hæmorrhage during life, though the patient lived in constant dread of the tumour bursting.

I have thought it better to correct these inaccuracies, though they do not affect the main conclusions as to the pathology or treatment of the disease in question, which are enforced in the essay. The mistake is only another illustration of the importance of accompanying morbid specimens (especially those of importance) by a reference to their history. This preparation was put up by Mr. Shaw, who also personally attended the patient.

NOTE TO THE ESSAY ON ANÆSTHETICS.

Since the article on Anæsthetics was printed, a death under chloroform has taken place in the operating theatre of the Edinburgh Infirmary. The author of the article was not present on the occasion, and does not feel able to present such an account of the occurrence as to afford instruction to the reader.

It appears also that there was another case of death under chloroform in the same theatre during the period of nine years, referred to at p. 497. But it is difficult, from the conflicting accounts which have been received, to determine what share the anæsthetic may have had in the fatal event.

SURGICAL DISEASES OF WOMEN.

IF, perhaps, we except diseases of the eye, no department of surgery has made greater advance within the last fifteen years than that which concerns the surgical diseases of women. In the successful treatment of vesico-vaginal fistula, and the radical cure of ovarian dropsy, we enumerate some of the most creditable achievements of modern surgery.

The space allowed by the present work will not permit of any thing approaching to a full dissertation on the various affections peculiar to women, which require surgical treatment. I shall, therefore, endeavour to keep closely to the more important parts of my subject, having regard especially to those diseases which permit of relief by operation. The following will be the arrangement of subjects treated of:

I. Urethral hæmorrhoids.
II. Malformations of the vagina or uterus.
III. Uterine polypus.
IV. Uterine fibroid tumours (in reference to surgical treatment).
V. Malignant disease of the cervix uteri.
VI. Malignant disease of the external genitals.
VII. Non-malignant disease of the external genitals.
VIII. Surgical measures in cases of extra-uterine pregnancy.
IX. Ruptured perineum, and its consequences.
X. Organic diseases of the ovary, and their surgical treatment.
XI. Vaginal fistula.
XII. The Cesarian section.

I. VASCULAR TUMOURS OF THE URETHRA.

Urethral hæmorrhoids, or vascular tumours of the meatus urinarius, are not uncommon in women of any age, though more frequent in young adults. They are sometimes single, but often multiple. They may be pedunculated or on broad bases. Their most frequent site is on the floor of the meatus, but they may occur at any part. They rarely extend far inwards, but sometimes sufficiently so to make their complete exposure difficult. Those with broad bases resemble very closely in all particulars the more vascular kind of piles; but those which have become pedunculated are of more fragile texture, and look more like small nævi. They are, however, never congenital, and in their mode of origin and real nature are probably analogous to anal piles. Their symptoms, also, making allowance for difference in site, are very similar to those of piles. Proneness to bleed, great sensitiveness, liability to become extruded and inflamed, pain during the escape of the visceral contents, are some symptoms which both diseases have in common.

The amount of suffering caused by these little growths is often exceedingly great. In some cases the pain is almost constant; in others it is only excited by irritation, as for instance the passage of urine over the growth. The quantity of blood lost may vary greatly, and in some cases, which are attended by great irritation, it may be very trivial. If a woman complains of pain in passing urine, with occasional bleeding, an examination should always be made, and in most such cases a urethral hæmorrhoid will be found.

Very often the irritation produced by these little growths suffices to cause serious constitutional disturbance. In one instance I have known urethral or urinary paraplegia to result; but this event is probably extremely rare.

Those who have had much experience in the treatment of these cases will acknowledge that their complete cure is often not easy. Although the little tumours seem to be very superficial, they are not really so; and unless the submucous base is destroyed, they quickly and pertinaciously grow again. The ligature, excision, and the cautery, either singly or combined, are our chief means of combating them. Whatever method is adopted should be boldly used. The application of any so-called mild caustic, as the nitrate of silver or sulphate of copper, can be productive only of mischievous irritation. The best caustics are the actual cautery or the acid nitrate of mercury; and of these the first is the most manageable, especially if a galvanic apparatus be employed. On the whole, perhaps the ligature is the most trustworthy plan. It must be applied by means of a fine tenaculum, by which the base of the tumour from behind forwards has been deeply transfixed, and over which the silk is applied. If only the crest of the growth be tied, the plan is worse than useless. By whatever plan we propose to operate, it is desirable that the patient should be under chloroform, and in the lithotomy position, and that the meatus should be well opened by means of bent probes.

II. Malformations of the Vagina or Uterus.

Cases of closure of the outlet of the vagina by adhesion of the labia in the middle line are not unfrequently brought under the notice of the surgeon. In these the anterior part is almost always open, so that there is room for the escape of the urine. The defect is usually discovered by the mother or nurse early, and the patient comes under care either in infancy or early childhood. At this age the adhesions are rarely strong, and may commonly be broken down by a director. The insertion of a strip of oiled lint prevents reuniting of the edges, and the cure is complete.

Ruysch and Delpech have each recorded a case in which adhesion of the labia was the cause of retained menses. In Ruysch's case, if not in both, there is, however, reason to doubt whether the occluding membrane was not an unusually thin and distended hymen. I have seen the hymen in cases of great distension pushed down external to the vulva.

In those cases, however, in which the vagina is closed higher up than the external outlet, the defect is but seldom discovered until menstruation is established. Very frequently the case is allowed to pass on until a large accumulation of retained menstrual fluid has taken place. Amongst the causes which may give rise to closure of the vagina we may class congenital malformations, imperforate hymen, and adhesion of the walls of the tube consequent on ulceration in early life. The first and the last are much less frequent than the second. It is scarcely necessary to point out that if by chance the fact of the existence of vaginal occlusion should come to the surgeon's knowledge prior to the establishment of menstruation, an early operation is very desirable. We shall have to show very shortly that even the simplest operations, when performed after menstrual accumulations have taken place, are attended with peculiar danger.

In any case of vaginal obstruction it is desirable, first, to ascertain the character, thickness, &c., of the occluding medium; and secondly, to determine, if possible, whether the uterus be present. In a large majority of cases the existence of an abdominal tumour, believed to be an intra-uterine collection of menstrual fluid, at once sets the latter question at rest.

The determination of the presence or absence of the uterus is in certain cases exceedingly difficult. If, however, the patient have attained adult age, and there have been no menstrual effort, and if on careful examination by the vagina and rectum the organ cannot be felt, a strong suspicion must be entertained that it does not exist. This suspicion will be strengthened if the vagina below the occlusion be much contracted, and if the walls of the bladder and rectum above it can be ascertained to be in near contact. The development or otherwise of sexual characteristics is of little value as a symptom, since it depends more upon the state of the ovaries than upon that of the uterus. Should there appear good reason to fear that the uterus is absent, and that the case is one of non-development of that organ and of the upper part of the vagina, no operation should be attempted, since any incisions of sufficient extent to clear up the doubt would be attended with much danger.

When there is evidence of the retention of menstrual fluid, and therefore of the presence of an uterus, and probably of a vaginal cavity above the occlusion, the case will come fairly under surgical treatment. In the first place, the character of the obstructing medium must be determined. If the obstruction be found within an inch or two inches of the vulva, and if it be constituted by a membrane, more or less thick and unyielding, stretched across an otherwise well-formed vagina, the case is probably one of imperforate hymen. In some of these, during coughing, the propulsion of the fluid downwards may easily be felt, or the distended membrane may even be forced as low as the vulva itself. In these cases the operation is in itself easy and simple, though, as we shall see shortly, by no means devoid of risk.

The method of operating in a case of imperforate hymen has usually been to make an incision of a crucial form in the centre of the membrane. The patient having been placed in the lithotomy position, is desired to force downwards, so as to distend the occluding structures, and a bistoury is then plunged into the centre. The opening thus made is subsequently widened, the finger being introduced and used as a director. If there be considerable redundancy of thin membrane, it may be feasible to dissect part of it away; but if otherwise, the free crucial incision will be amply sufficient, and will not be attended by any subsequent inconvenience, due care being taken to prevent contraction during the first week or two. Mr. Baker Brown has advised strongly that the hymen should in all cases be dissected away; but it is impossible to believe with him that, when this is not done, 'vaginitis is very apt to be set up by the friction of the surfaces upon each other,' and that 'this inflammation may extend to the uterus, Fallopian tubes, and peritoneum.' Most surgeons will probably incline to the opinion that a free crucial opening is likely to incur less risk of inflammation than an operation in which 'the hymen is removed entire by a circular incision;' nor is it needful to point out which of the two methods most closely imitates nature's procedure.

That a free crucial incision is amply sufficient as regards providing free space for all the functions of the tube, there can be no practical doubt. Indeed, since no mucous membrane is removed, it is probably less likely to be followed by any thing like cicatricial stricture than would the plan proposed by Mr. Brown. In one case in which I adopted the crucial incision, and in which the diaphragm was very thick, the patient subsequently married, and has since borne several children. At the present time there is not the slightest perceptible narrowing of the vagina at the part.

Although, however, the operation in cases of retained menses from imperforate hymen is easy enough, yet clinical experience has shown that it is attended by much danger to life. In a very considerable proportion of such cases, within a few days of the operation, peritonitis comes on, and death ensues. Whence this risk? That it is not connected with the extent of the incisions or the nature of the parts incised, is quite evident; for it has occurred in some in which nothing was done beyond a mere puncture in a thin membrane. Nor can it be attributed, as Dr. Blundell suggested, to a disease derived by contagion analogous to puerperal peritonitis, since it has happened in private practice and in districts in which no puerperal disease was prevalent.

Let me cite the following example, which came under my own notice. A very healthy girl, aged sixteen, residing at a village near York, came under treatment in May 1851, on account of retained menses. On examination a round elastic tense body, the size of an orange, was found protruding between the labia. A common lancet was plunged into the centre of this swelling, and a stream of dark treacle-like fluid without smell followed. About two quarts were discharged. On the second day after the incision slight chilliness occurred; on the third she was feverish, and the vaginal fluid had an offensive smell. On the fifth day the existence of peritonitis was very evident; and she had a rapid pulse and foul tongue. From this date she passed into a condition of low irritative fever, attended with much sickness, &c.; and death took place on the twenty-fourth day. No post-mortem examination was obtained. It was impossible that less could have been done, or under more favourable circumstances, than in this case. Yet it is a good example of what often follows the puncture of an imperforate hymen. In some, death takes place even within a few days of the operation (if such it can be called); whilst in a few the patients, after severe peritonitis, ultimately recover. If ill symptoms have, however, once set in, the chance of recovery is small; the cases which do well (happily a large majority of the whole) usually progress from first to last without any drawback, and without the slightest indication of peritoneal irritation.

Two suggestions occur by which to explain the danger attending this operation. First, it may easily be supposed that the retained menstrual fluid is in a condition peculiarly apt to undergo decomposition as soon as air is admitted, and not unlikely when decomposed to induce a form of endometritis, which might pass on to a condition closely analogous to that of puerperal fever. The second explanation is one that would not have occurred to the mind had it not been demonstrated by post-mortem observation. It is, that some of the retained fluid finds its way upwards, through the free extremity of the Fallopian tube, into the sac of the peritoneum. That in cases of retained menses the Fallopian tubes, as well as the uterine cavity, are often very greatly dilated, has been repeatedly witnessed. But why should a dilated tube which never permitted the escape of its contents before the operation do so afterwards? It might have been supposed that, prior to the incision of the occluding membrane, and that especially during the state of tension produced by a menstrual nixus, the risk of extravasation upwards would be considerable, and that it would cease at once when an outlet downwards was provided. The clinical fact is, however, the reverse; and whilst it is very rare for such escape to take place prior to the incision of the hymen, it is by no means infrequent within a few days afterwards.

To MM. Bernutz and Goupil* we are indebted for the best collection of facts and arguments bearing upon this part of our subject. In some instances there has been found evidence of ulceration at or near the free extremity of the Fallopian tube, but in others the fluid could only have escaped from the free extremity itself.

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* See their excellent *Clinique médicale sur les Maladies des Femmes;* article, Rétention du flux menstruel, or, New Sydenham Society's translation, vol. i. p. 1, et seq.

Sir Benjamin Brodie* has mentioned two cases in which peritonitis followed this operation. In one, the patient with difficulty recovered; in the other, death took place. At the autopsy in the latter a large quantity of menstrual fluid was found in the abdomen, but there was no rupture either of the uterus or of any part of either Fallopian tube. In a case recorded by M. Locatelli, and quoted by MM. Bernutz and Goupil, full details of the autopsy are given. In this case death followed on the third day. One Fallopian tube was found dilated to the size of a nut, the other to that of a turkey's egg. The latter had ruptured behind, and in the peritoneal cavity was a small quantity of black half-putrefied blood, exactly similar to that contained in the tube. The dilated tubes were adherent to their respective ovaries, and communicated with the uterus by extremely narrow canals. Mr. Paget of Leicester has also published a case in which a young lady of eighteen died on the fifth day after an incision through an imperforate hymen. At the autopsy the Fallopian tubes and ovaries were found dilated, until each would have held a pint of fluid. Both these tubal-sacs had ulcerated and given way, the edges of the openings looking as if recently torn. In the peritoneal cavity was a pint and a half of black fluid, exactly similar to that removed from the vagina.†

In proof that rupture of the distended Fallopian tube may occasionally happen without any operation having been performed, is a case given by Dr. Munk,‡ in which a girl of eighteen, who had never menstruated, died after a three-days' illness, with symptoms of acute peritonitis. There was found after death an imperforate vagina, consequent apparently on cicatricial adhesions. In the peritoneal sac was a large quantity of thick blood, of similar character to that which, to the quantity of about five ounces, occupied the uterine cavity. Both Fallopian tubes were dilated sufficiently to admit a finger, and near the extremity of the left was a small laceration, from which the fluid had escaped.

These cases illustrate clearly the chief danger to which patients after this operation are exposed. The only explanation which can be given as to why these Fallopian lacerations should be so prone to occur immediately after operations is, that the uterus, by its contractions after evacuation, may possibly drive a certain portion of fluid backwards. It may easily be supposed that the tubes already distended and thinned are unable to empty themselves quickly, whilst a powerful organ like the uterus, excited to contraction by the escape of its contents, would rapidly do so, and thus close the apertures of communication.

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* *Lond. Med. Gaz.* vol. xxvii. p. 810.

† *British Medical Journal,* July 23, 1859.

‡ *Lond. Med. Gaz.* vol. xxvii. p. 867.

As I am not aware of any published cases of death after incision of imperforate hymen in which there was post-mortem proof that no escape of fluid into the abdomen had taken place, it seems probable that this occurrence is the main risk which we have to encounter. The problem, how to obviate it, is one of great difficulty. It is not practicable to avoid such operations altogether; and were it so, as Dr. Munk's case proves, no immunity could be obtained. Sooner or later the dreaded event would probably take place. To make a very small incision, and thus allow the fluid to drain slowly off, instead of at once permitting the uterus to empty itself, has been proposed, and with much plausibility. To accomplish this, the introduction of a small drainage-tube by means of a trocar and canula would perhaps be the best method. Still it is probable that, however slow the escape might be, the uterus would claim preference for itself, and act energetically throughout the whole time, thus preventing the evacuation of the thin and feebly-muscular tubes. With the view of retarding this action, it might possibly be well to put the patient before the puncture under the full influence of tartar emetic, and to keep her nauseated for twenty-four hours afterwards. Under such circumstances the freer the opening the better. *With the hope of anticipating the dilatation of the tubes, early operations should always be performed in cases of occluded vagina.*

The above statements apply to all operations in which there has been retention of menses, whatever may have been the cause. Probably they include the only source of danger to which, in simple cases of imperforate hymen, the patient is exposed. In cases of obliteration of the vagina, however, other risks attend any attempt at operative relief. In these cases the operation is in itself a more or less difficult process of dissection, and there is danger that either the bladder, the rectum, or even the peritoneum itself, may be wounded. No two cases are alike, and it is impossible to lay down rules for the surgeon's guidance, beyond insisting upon the necessity for ascertaining as exactly as possible the thickness of the occluding tissues, and the relative position of the bladder and rectum. It is surely, when doubt is present, better to dissect cautiously than to employ a trocar.

In 1859 I had the pleasure of performing, in consultation with Dr. West, a successful operation in a case of this kind which had given us much anxiety. The young lady was the daughter of a surgeon, himself only too well aware of the peculiar risks which attached to the procedure. The vagina was about an inch and a half in depth, ending in a cul-de-sac. By the rectum a fluctuating and very tense tumour could be felt; but below this the bowel and the bladder were in almost close apposition, and the uniting structures were very firm. The operation consisted in dissecting through the septum very cautiously, all the incisions being made from side to side, and the forefinger being kept in the wound to press back the bowel. At length the upper cavity of the vagina was reached, and a gush of thick tar-like fluid escaped. The os uteri was found closely united to the septum just above the opening. The incision was enlarged sufficiently to allow of the free escape of the fluid; but in the subsequent management of the case it was needful to employ sponge tents to keep it open. The patient recovered without ill symptoms, and afterwards menstruated regularly and without pain. Her death occurred, however, about six years afterwards, in connection with an ovarian abscess. The canal had unfortunately been allowed to contract and was much narrowed.

The importance of attending to the opening for some weeks or even months after the operation is proved by the fact, that occasionally second operations have been requisite; and in one case, a patient who had survived the first died after the second.

In rare instances, if it be not thought practicable to reach the uterus from the vagina, puncture of the tumour per rectum, and the establishment of a recto-uterine fistula, may be desirable.

Cases in which the cervix uteri itself is the part which is obliterated occur every now and then, and require surgical relief on account of retained menses. Their management must be conducted on the same general principles as in obliteration of the upper part of the vagina, from which, indeed, it is often difficult to distinguish them.

III. UTERINE POLYPUS.

Uterine polypus.—Hæmorrhage is by far the most important sign of polypus uteri. Whenever the symptom of frequent and irregular discharges of blood from the vagina is present, and has lasted for some time and resisted ordinary treatment, the surgeon should on no account defer an examination. The speculum as well as the finger should be used. In such cases, if the conjecture has been correct, one of the following conditions may be found: (*a*) a sessile soft growth of small size, containing one or more mucous cysts,* consisting of enlarged uterine follicles and hypertrophied cellular tissue; (*b*) a pedunculated growth of small size (a bean to a nut), soft, vascular, and often multiple, consisting of pendulous mucous membrane, and analogous to the mucous polypus of the nares; (*c*) a growth of finer texture and larger size than the latter (a nut to an egg), more or less pedunculated, and made up of mucous membrane, with a large excess of cellular tissue; (*d*) a much firmer growth than any of the preceding, and usually a much larger one, either pedunculated or sessile, its attachment usually passing up into the interior of the womb—the common fibrous polypus (Fig. 309). We will omit for the present all varieties of malignant disease, any of which may occasion hæmorrhage, and in rare instances may even form growths of somewhat polypoid shape; and also those cases of fibrous tumours in which the growth is as yet embedded in the exterior walls, in which latter hæmorrhage is also a most important sign.

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* Now and then pedunculated cysts attached to the cervix uteri constitute polypi. Dr. Robert Lee has stated that one of the glandulæ Nabothi may be 'converted into a cyst as large as a walnut, or even a hen's egg,' and hanging by a slender peduncle. *Medico-Chirurgical Trans.* vol. xix. p. 127.

Fig. 309.

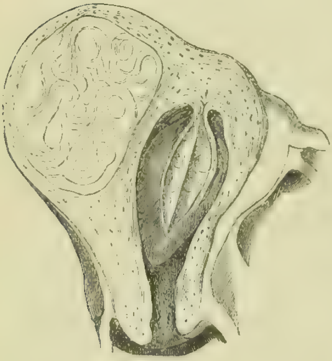

Diagram showing two uterine fibroid tumours, one of which had passed downwards and become a polypus, the other being still encapsuled in the parietes.

Women of all ages are liable to the development of uterine polypi, but these growths are much more common during the period of menstrual activity than either in very early or in later life. In addition to the bleeding usually caused, we have in most cases leucorrhœal discharge, and more or less of bearing-down pain. The amount and frequency of the hæmorrhage is often diminished when the polypus escapes from the grasp of the cervix; and it also, as a rule, lessens in proportion as the pedicle becomes longer and thinner.

In addition to the four varieties of simple polypus above mentioned, we have in rare instances a form of tumour developed within the cavity of the uterus which is closely analogous to the recurrent fibroid in other parts. This tumour grows rapidly, assumes a polypoid form, attains a large size, and causes much bleeding. It can scarcely rank with true cancers, because it does not induce enlargements of the lymphatics or secondary deposits; but it differs from all the forms of simple polypus, in that it persistently grows again after removal. It, like the fibrous polypus, may have its attachment high up in the interior of the uterus.

The surgical treatment of small polypi is usually sufficiently easy. They may be removed by scissors, by torsion, by ligature, or by the écraseur. In all cases in which the pedicle is long and thin, either to snip it through with scissors, or to twist it by means of forceps until it gives way, is the best plan. There is little or no danger of serious hæmorrhage. The operation should always be performed with the part well exposed by means of the bivalve speculum. In the case of the softer and more sessile forms it will be well to follow a practice strongly recommended by Dr. West, and touch the cut surface with the solid nitrate of silver. Unless the fear of bleeding renders the ligature the only safe plan, it is better to avoid it, as we escape by doing so the disagreeable consequence of a fœtid mass remaining for some days in the vagina.

The position of the attachment of the polypus is of great importance in deciding what method of treatment should be adopted. As a rule it may be stated, however, that all the forms excepting the fibrous and recurrent fibroid are attached low down, either to one lip or just within the cervix. If the attachment is high in the cervix, it may become desirable to dilate the latter by the use of sponge tents.

The fibrous (or, more correctly, musculo-fibroid) polypus is the most common, and as it is the only one (the very rare recurrent form excepted) which attains to a large size, it is the only one which for its safe removal requires any large amount of surgical ingenuity. The pathology of this form is now well understood, and it is generally recognised as consisting of an ordinary uterine fibroid growth, which has passed downwards, receiving an investment of mucous membrane. Dr. West has, however, directed attention to the fact that in some cases the fibrous tumour which has become polypoid is not separable from its investment, but is continuous with the uterine tissue. This is very exceptional. Although prone to cause profuse bleedings whilst *in situ*, neither the substance of a fibrous polypus nor its investing membrane contain any large vessels. No fact is more clearly proven by clinical experience than that these tumours, when cut into, or when detached by section of their pedicle, do not cause any dangerous amount of hæmorrhage.

If a fibrous uterine tumour has become pedunculated and is the source of bleeding, it is the surgeon's duty to remove it. The procedures by which its removal may be effected are three: by ligature, by excision, or by the écraseur. A large majority of surgeons of the present day who have had much to do with these cases have recorded opinions adverse to the use of the ligature. If the pedicle be large, the ligature requires some days to cut its way through, and during that time the patient is exposed to the inconvenience and danger of a decomposing mass lodged in the vagina. This source of risk is not chimerical. A large fatality has attended the use of the ligature in the hands of all who have employed it much. Of twenty cases recorded by Dr. Robert Lee, nine ended fatally. This proportion is probably too high; but almost all surgeons will be able from individual experience to attest the fact that deaths do not unfrequently follow its use. Sir J. Simpson, and Dr. M'Clintock of Dublin, have both recorded facts and opinions adverse to the ligature. On the other hand, Dr. West states, that of twelve cases in which he practised excision, all recovered without either hæmorrhage or any untoward symptom; and Dupuytren, Velpeau, and Lisfranc have given similar testimony based on large collections of facts. I am not aware that any cases of fatal hæmorrhage have been recorded. If, however, any fear should still be felt on this score, we have the écraseur, by which the gains of both methods may be combined, and the tumour may be taken away at the time without any risk of hæmorrhage. It is, however, often difficult to apply.

The operation of excision may be thus performed: The patient should be in the lithotomy position, and the tumour should be carefully drawn down by forceps or hooks into the external parts. Not unfrequently its pedicle may be brought almost to a level with the vulva, and then it is easily cut through with scissors.* If, however, it cannot be got so low the scissors may still be quite safely used, the vagina being opened by a duck-billed spatula, and the forefinger of the left hand employed as a guide. Various forms of knives, mostly bent at the end, have been contrived for the special purpose of severing the pedicle in cases in which it is unusually high up. Sometimes, even after the tumour has been detached, much difficulty is encountered in removing it from the vagina. Dr. West mentions that he has been compelled to resort to midwifery-forceps for that purpose; and the same necessity has occurred to myself.

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* Whenever it is needful to use scissors or forceps high up in the vagina, it is a convenient plan to protect their hinges, &c., by drawing over them a piece of sheet india-rubber, sewn so as to form a tube of requisite tightness. In this way only the end of the blades need be left exposed, and there is no risk of folds of mucous membrane getting crushed in the joints, or between the upper parts of the handles.

After the removal of a fibrous polypus the stump of its peduncle will wither, and there is no risk whatever of recurrence. As, however, fibrous tumours of the uterus are often multiple, it is very possible that a second may descend and become polypoid. The recurrent fibroid polypus is, like its allied growths in other parts of the body, very prompt and pertinacious in its return. It is, indeed, difficult, if not impossible, to effect its complete removal.

But few examples of this form of growth are on record. In one treated by Dr. Atlee of Philadelphia, between 1846 and 1851, four operations were performed, and with the result probably of greatly protracting the patient's life. In my own case two incomplete operations were performed within six months, and after each the patient was temporarily much benefited; she died, however, within three years of the first appearance of the growth.* A third case is recorded by Dr. West.† In it nine incomplete attempts at removal were made within about fifteen months; but although the tumour was greatly diminished, it was never wholly got away. Death took place nearly

FIG. 310.

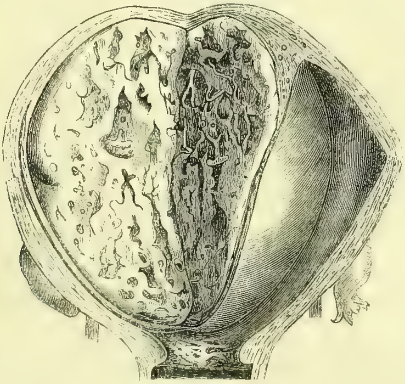

Diagram of a large soft-structured fibroid tumour, developed in the uterine wall, and filling its cavity. (Compare with case referred to in the text, and figured in *Path. Trans.* vol. viii.)

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* *Pathological Society's Transactions*, vol. viii. p. 287, with plates showing the connections of the base of tumour to the uterine walls, and also its microscopic elements.

† See *On Diseases of Women*, p. 331, et seq.

four years after the last, and more than six from the first appearance of the disease.* Dr. West, who gives an excellent *résumé* of our present knowledge of these cases, concludes respecting the treatment: 'It may, however, be doubted whether our wiser course is not to let the disease alone; for while its complete removal seems impossible, its partial extirpation seems to be followed by an increased rapidity in its production.' It may be added, that treatment by caustic injections into the substance of the tumour was tried, both in Dr. West's case and my own, but without good results.

IV. Fibrous Tumours of the Uterus, in Reference to Surgical Treatment.

It is chiefly in reference to the feasibility of attempting their removal by enucleation that fibrous tumours of the uterus become of interest to the surgeon. Although in many cases these tumours occasion but little inconvenience, and it is not at all uncommon to find them embedded in the uterine wall or pedunculated in the abdomen in cases in which their presence had never been suspected during life, yet in other instances they cause constant suffering, and imperil life. When we remember that they possess, in the majority of cases, but very slight connection either vascular or fibrous with the uterine structures, it is not to be wondered at, that attempts to enucleate and remove them should have been made. It is, however, chiefly within the last twenty years that this mode of dealing with them has been resorted to; and hitherto, with the exception of Sir J. Simpson, Mr. Teale, and Mr. Baker Brown, but few British surgeons have been bold enough to attempt it. In France, Lisfranc, Jarjavay, Amussat, and Maisonneuve, and in America, Dr. Atlee, have advocated and practised it, the experience of the latter surgeon being indeed almost equal to that of all the others together. It is clear that attempts of this kind will vary much in their difficulty, and in the danger attaching to them, in proportion as the tumour may protrude into the uterine or vaginal cavity. The distinction between a 'fibrous tumour' and a 'fibrous polypus' depends solely upon the position of the growth in regard to the uterine walls; and in proportion as the tumour approaches the pedunculated or polypoid form, does its removal become easy. I shall enter at some length into the details of the enucleation process, not from any wish to advocate its claims to more frequent adoption, but because, since in some rare cases it is certainly advisable, it becomes desirable that all the light which can be derived from past experience should be made available. In the *Medical Times and Gazette* for August 1857, I published, in a tabular form, all the cases of enucleation operations which I could then collect. They amounted to thirty-nine, the greater portion being either Continental or American. Upon the careful examination of these cases the following remarks are based.

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* For account of the autopsy (by Mr. Callender) see *Path. Trans.* vol. ix. 327.

First, let me remark that enucleation operations may be conveniently divided into two groups, since in some the intention has been to remove the tumour at the time, in others only to disturb its relations and inflict such injury upon its vitality as to induce its sloughing. By the latter method several operations, after intervals of time, are usually requisite. The former, of course, give us far more serious operations; but in the latter the process is a gradual one, and therefore the risk attending it is protracted over a much longer space of time. If the indications of the following table might be relied on, it would appear that the gross risk of the two modes is almost equal, and that, under either, about two-thirds of the cases end in recovery. We must examine the comparative merits of the two in a little more detail. Of the thirty-nine cases above alluded to as recorded in the *Medical Times and Gazette*, the following is a statistical summary:

Method pursued.	Number.	Recovered.	Died.
Primary enucleations (completed)	18	12	6
Ditto (attempted but not completed)	6	4	2
Enucleation by inducing gangrene	15	9	6

Primary enucleation.—Were certain cases in which enucleation by gangrene has been practised in Edinburgh added to the above table, that method would, it is believed, compare with still less advantage with the primary mode than it now does. But the truth is, that the cases in which it was pursued have been, as a rule, much more serious ones than those in the first list. In most the tumour was of a very large size, and either actually embedded in uterine tissue, or at any rate wholly enclosed within the cavity of the womb. Under the head of 'Primary Enucleations,' on the other hand, are included several cases in which the tumour was of small size (less than a pear), and several others in which it was already somewhat polypoid in shape, having been partially extruded by the spontaneous contractions of the organ. In these, of course, the danger to life would be comparatively but little. Of cases in which the tumour was of considerable size, intra-parietal, and not protruding either into the uterine cavity or the vagina, and in which, consequently, primary enucleation was undertaken under the most dangerous circumstances, we have thirteen; and of these seven ended in recovery, and six in death. In the less serious class, those, namely, in which either the tumour was small in size or already projected considerably, we have ten, out of which only two ended fatally; and of these two, in one the tumour, although projecting into the uterine cavity, was so large that its removal had been found impracticable. It is evident, therefore, that in cases in which the two conditions of moderate size and of somewhat depending position are combined, the operation of primary removal by incisions and the use of the finger is attended by very little danger. In those in which the growth is of large size and completely embedded, the chance of recovery after its removal is about equal to the risk of death. In the largest of all, those, for instance, in which the tumour approaches the size of an adult head, no surgeon would ever dream of primary enucleation. Among the causes of death, we find peritonitis and inflammation of the pelvic cellular tissue to be by far the most frequent. The hæmorrhage, with one or two exceptions, is stated to have been insignificant; and very few appear to have died directly from the shock of the operation. Although in several the operators state that they felt themselves at the time in great risk of lacerating the peritoneal investment of the uterus, where spread over the surface of the tumour, yet that accident does not seem to have ever actually occurred. In only one case is it stated that any serious hæmorrhage continued after the operation was concluded. Among the cases which recovered, in not a few the patients were very ill indeed, and had narrow escapes of death, either from peritonitis or exhaustion.

Mode of performing the operation.—Whoever has either witnessed its performance, or read the detailed accounts given in some of the French narratives, will have no difficulty in admitting that the enucleation of a large embedded uterine tumour is an operation which will tax both the patience and skill of the operator. In not a few on record it occupied between two and three hours in its performance, and presented such obstacles that the operators were repeatedly on the point of relinquishing their task. The circumstance that these tumours not unfrequently occur to single women, in whom the vagina is narrow, often adds to the difficulties of the case. It is of course impossible to give rules which should be applicable to all; but the following memoranda are the result of much investigation, and a careful perusal of all that has been recorded, and will probably be useful to any one who may contemplate the performance of this operation for the first time.

1st. To have the tumour well depressed into the pelvis by an assistant. 2nd. To let the first incisions be very free, and pass deeply into the tumour, thus not only completely dividing its capsule, but facilitating its bisection, should that afterwards be found requisite. This first incision should be made with a scalpel. In most cases it will be found convenient to pass the knife into the uterine cavity, and then, turning its edge on to the tumour, cut downwards, and either forwards or backwards, according as the mass may occupy either the anterior or posterior wall. All experience goes to show that no important hæmorrhage is to be feared from this incision, and if directed in the manner indicated, the whole substance of the tumour will intervene between the knife and the peritoneum. 3rd. The capsule of the tumour having been opened, its separation should next be effected by means of the finger, or, if needful, by blunt-pointed curved scissors, the finger being used as a director. 4th. The surgeon should be provided for this part of the operation with a set of curved scissors of various sizes and shapes; one pair at least should be very long indeed. He should also have several pairs of strong and large vulsella, a spatula, a blunt hook, a scoop, and a pair of small midwifery forceps. In some cases the operator appears to have been baffled for want of vulsella of proper size and strength for securely holding the tumour. A strong whipcord ligature, and the various appliances for its use, should be in readiness in case of need. 5th. The grand object of the operator, after having separated the tumour from its cyst-wall sufficiently to allow of its lower part being seized, is to invert the uterus, and drag that viscus, together with the tumour, to the external parts. If this be accomplished, the main difficulty of the operation—that, namely, of working in a confined space—is overcome, and a speedy conclusion may be effected. To do this, a large vulsellum should be carefully planted in the mass, and traction, at first gentle, afterwards vigorous, must be exerted. The axes of the pelvis must of course be carefully observed, and the traction must be steady and not by jerks. As soon as practicable, a second vulsellum must be placed above the first, or if more convenient the midwifery forceps may be employed. 6th. After eversion has been accomplished, an examination with the finger in the rectum should be made, and the relative position of parts having been duly ascertained, the remaining attachments of the tumour must be cautiously separated. The utmost care must be exercised not to cut into an inverted pouch of peritoneum. 7th. It is very possible, if the tumour be a large one, that it will be found convenient, before drawing it down, to cut away a portion or portions, and thus diminish its bulk. 8th. It is needless to remark, that throughout the utmost patience must be exercised, and as much gentleness as is consistent with the requisite degree of force. 9th. The operation complete, the everted uterus must be returned; if needful, a sponge plug should be introduced, and a full dose of opium should be given. 10th. The use of ice, of the ergot, and of diffusible stimuli, must be resorted to, or not, according as circumstances may require.

Enucleation by inducing gangrene.—This method, if we count those in which primary enucleation was attempted, but could not be effected, and include also a few others not yet on record, has been performed in about 27 cases; out of these there have been about 13 deaths, 10 recoveries, and 4 incomplete cases, in which either it was known that the whole of the tumour had not come away, or there was a return so soon as to render it highly probable that some part had been left behind. Almost all these were cases in which the tumour was of very large size, and in several the operation was undertaken on account of immediate urgency, and after the patient had been reduced to the very lowest stage by hæmorrhage. Thus it appears probable that of cases of this class somewhat more than one-half may be expected to come safely through the risks incident to the procedure, and rather less than half to result in complete cures. It must be borne in mind that a large majority —indeed, almost the whole—were out of all possibility of treatment by the primary method. This plan has the recommendation of being an attempt to imitate nature. Although confessedly very infrequent, yet cases have occurred in which fibrous tumours of the womb have sloughed, and been extruded from their bed without the assistance of the surgeon.*

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* For an interesting example of this, see Mr. Grimsdale's paper in the *Liverpool Medico-Chirurgical Journal*, No. I. I do not know where to turn for

A far more common event than this is for them to become pedunculated, and assume the polypoid form, without wholly losing their connections to the uterus. Although but few facts exist on which to ground a positive opinion, yet judging from those which have fallen under my notice, I suspect that the fatality of the cases in which spontaneous extrusion has occurred has been little less than that of those in which it has been induced artificially. The process is one always attended with much constitutional irritation. Although no single operation is required in itself involving much risk, yet with a large sloughing mass in such an important position, with fœtid discharges continuing for several weeks, the patient is kept for a considerable time in constant danger of the development of some fatal complication in the form of pyæmia, peritonitis, or a low type of inflammation of some of the internal viscera. Repeated, if not almost daily, manipulations are needed, and the increased risk of some contagion, either of erysipelas or pyæmia, being thus conveyed by the surgeon, must not be lost sight of, especially if the patient be an inmate of a hospital.

Then, again, it must be borne in mind that the patient has been reduced by long-continued hæmorrhage, and that in all probability her vital organs are already, to some extent, in a state of fatty degeneration; a condition which, under the evil influence of profuse suppuration, is not unlikely to become rapidly advanced to a degree incompatible with continuance of function. These kinds of risks render the operation one which will always be attended with much danger, and it must be admitted that it is one which ought never to be performed in a hospital ward. A healthy locality, and privacy in a large, well-ventilated room, with the undivided attentions of a nurse, should be regarded as essential conditions. With these, and with most persevering attention to all minutiæ of the medical and dietetic management of the patient, it may, perhaps, be reasonably expected that the mortality, even in severe cases, might not exceed

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the record of an instance of *spontaneous piecemeal* disintegration, such as occurs in the cases surgically treated. One such, however, happened in St. Bartholomew's about ten years ago, the patient being one of the ward-nurses, and its particulars were mentioned to me, in conversation, by Mr. Paget. The woman recovered; but Dr. West has informed me that subsequently another tumour protruded, as a polypus, was removed by ligature, and that death from pyæmia followed.

a third; but there are certainly, thus far, no grounds for expecting better success than this.

With regard to the plan of operating, it would appear that the knife possesses great advantages over escharotics. The object is as much as possible to separate the adhesions of the tumour from its cyst, and to thus cut off its vascular supply. Now the effect of the application of escharotics is well known to be to induce the union of subjacent parts, and of this the surgeon not unfrequently avails himself; as in the instance of abscess in the liver, requiring to be opened externally. The dread of hæmorrhage from the incisions has been proved to be for the most part a chimera, and the prevention of this is, as far as we can see, the only shadow of an advantage which can be claimed for the escharotic plan. By means of a free incision, the surgeon may not only divide the capsule thoroughly. but damage the tumour itself, and facilitate the employment of the finger in accomplishing the separation of the cyst-wall to as great an extent as practicable. The usefulness of ergot, after a free opening has been made, and the certainty of its action in promoting the expulsion of the tumour, is a point on which all observers agree. Whether or not an attempt should be made to accomplish the enucleation of the sloughing mass, by the hand, within a week or two of the commencement of the treatment, or whether it should rather be left to disintegrate and come away in fragments, is a point which the circumstances of the particular case must decide. Dr. Atlee's experience seems to be, that the tumour may be left to disintegrate, with very good confidence (provided it has been well exposed and freely cut into) that such results will ensue; and some facts which have fallen under the writer's observation lead him to give full credence to this *à priori* improbable statement. The vitality of many uterine fibroids appears to be very small indeed, and comparatively little interference will often suffice to insure their death; whilst the manner in which large tumours, when they have once become sloughy, will, as it were, melt away, is quite astonishing.

What events may be expected when fibrous tumours are not interfered with? The determination of the feasibility of the enucleation treatment does not rest solely on an accurate estimate of the amount of risk which inevitably attends it. We must consider the other alternatives which are offered us. And here, in truth, is by far the greatest difficulty of the question. If these tumours were always fatal within a short space of time, no one would hesitate to recommend a procedure that offers a fair chance of a complete cure in a proportion of about two-thirds. But we know, on the other hand, that they are by no means of infrequent occurrence, and often cause to their possessors exceedingly little inconvenience. In cases, too, in which during one stage, and that often a protracted one, repeated and exhausting hæmorrhages have occurred, we know that not infrequently the tumour will either alter its position, diminish in size, or undergo such modification in its relations that the troublesome symptoms may cease to occur, and the patient be restored to health. On this point we will quote only the confirmatory testimony of Lisfranc, which is the more valuable because it comes from an ultra-partisan of the operation. After speaking of temporary abatement of symptoms, that surgeon writes: 'Il est des personnes plus heureuses; après avoir éprouvé pendant quelques années des douleurs violentes, des pesantures fort incommodes, des pertes très-abondantes, beaucoup de troubles dans les fonctions digestives, &c., elles voient ces phénomènes morbides se dissiper; l'embonpoint renaît et même quelquefois la fraîcheur: il existe seulement un peu de flueurs blanches, une légère pesanteur et quelques petites douleurs dans les reins; j'en soigne plusieurs qui, portant des matrices énormes et fortement bosselées, fournissent depuis dix ou douze ans leur carrière avec les faibles inconvénients que j'ai indiqués; elles semblent promettre de la poursuivre longtemps et peut-être même, à l'aide des moyens hygiéniques et de quelques soins thérapeutiques, comme si l'utérus était à l'état sain.' *Clin. Chir. de la Pitié*, vol. iii. p. 16. Researches in the pathological theatres show us what these changes are, the effects of which we have noticed in our patients. Uterine tumours are often found contracted and to a large extent calcified; or they may be lodged in the outer part of the uterus, or even pedunculated into the peritoneal cavity. We might also mention. under the possible events which may obviate the necessity of an operation, that spontaneous enucleation may occur; but, as we have seen above that the risks attending this process are probably as great as when the surgeon interferes, it need not claim much attention. Thus, then, there are probably but very few cases in which the conscientious surgeon could say to his patient that there was no chance of recovery without an operation. Still, however, that numerous deaths from these tumours do occur is undoubted; *

FIG. 311.

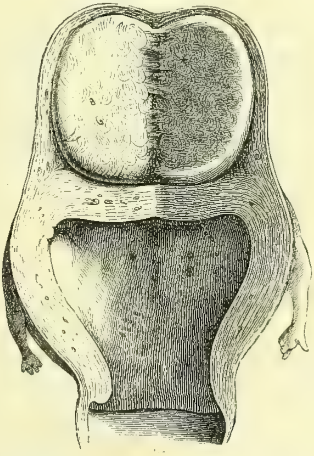

Diagram showing a uterine fibroid encapsuled in the fundus of the organ, and likely to grow upwards into the abdomen.

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* An instructive and warning case of death from a fibrous tumour, which was in slow process of spontaneous extrusion, is given by Mr. Grimsdale in the paper already referred to. The tumour was found after death to have been well suited for removal by operation. Many such cases might doubtless be collected. I refer to Mr. Grimsdale's paper with much pleasure, on account of the ability and candour which characterise it. Those who contemplate the performance of operations of this kind will do well to refer to it, as also to the detailed descriptions which have been given by French surgeons.

and in certain cases the amount of reasonable hope is, it will generally be admitted, very small indeed. While, therefore, the indiscriminate performance of these operations would be exceedingly unwise and wrong, yet we cannot but think that the reverse is the case under conditions of urgency. It happens very fortunately that tumours which cause serious symptoms are usually those most easily accessible. The proximity of the tumour to the mucous membrane of the uterus or vagina, but especially to that of the uterus, appears to be the main determining cause of hæmorrhage, and just in proportion as the mass bulges inwards is of course its suitability for enucleation. Tumours of very large size have, on the contrary, usually risen well out of the pelvis, and the symptoms attending them are often comparatively insignificant.

Conclusions.—I state the following as conclusions, not in any dogmatic or positive sense of the term; they are the impressions arrived at after much careful study of the subject, but further experience may very likely modify some of them:

1. That surgical interference with interstitial fibrous tumours of the uterus is always attended with very considerable risk, and ought not to be practised except under circumstances of urgency, or when the position of the growth is peculiarly tempting.

2. That when the tumour is not of very large size, and is already partially extruded, the operation is rendered comparatively devoid of danger, and ought to be performed at once.

3. That when the tumour is as yet wholly embedded, and even when of large size, the enucleation treatment is yet warrantable, if the patient's life be threatened by hæmorrhage.

4. That primary enucleation, where at all easily practicable, is much preferable to the secondary method.

5. That where the tumour is very large, or where found after the incisions to be firmly united to its capsule, the secondary plan should be preferred.

6. That whichever plan it is intended to adopt, the first incision should, excepting under unusual circumstances, be made from within the cavity of the cervix, and should be as free as possible.

7. That the danger of hæmorrhage from this incision is very slight indeed.

8. That as much should be done as practicable at the first operation in freeing the tumour from its cyst. Thus if the adhesions be found more loose than had been expected, a primary enucleation may be completed where the slower plan had been proposed.

9. That the after-treatment, in cases of primary enucleation, should consist in warding off the shock by opiates, in sustaining the strength, and in the free use of stimuli and nutritious diet.

10. That in cases of secondary enucleation the ergot of rye should be administered, so as to keep up vigorous uterine action; and that the greatest attention should be paid to sustaining the patient's strength, and to the removal of discharge and shreds of slough, as fast as formed.

11. That in cases of great exhaustion and threatened pelvic inflammation the internal use of turpentine is of great value.

12. That in cases of secondary enucleation the surgeon need not be anxious about the removal of the tumour *en masse*, but may confidently expect that, if it have taken on a sloughy state in its lower part, the death and piecemeal disintegration of the whole will follow.

13. That the 'recurrent fibroid' tumours slough away yet more readily after interference than the true fibrous ones, although liable to return after a short interval.

14. That after a successful enucleation-procedure, complete, though gradual, restoration to good health may be expected.

V. CANCER OF THE UTERUS IN REFERENCE TO SURGICAL TREATMENT.

Malignant disease of the uterus rarely presents itself to our notice in a stage permitting of surgical cure. Including in that term the so-called cauliflower excrescence, the epithelial cancer, and the medullary cancer, the remark still applies to all, that they have usually advanced too widely when the surgeon is first consulted, to allow of the satisfactory employment either of the knife or caustics.* In a vast majority of cases, all these forms of morbid growth begin at or very near to the os uteri; and if discovered early, would probably admit of removal, in many instances, with benefit more or less lasting. In all, however, the ulceration extends rapidly, and the patient does not submit to an examination until already the vaginal tissues have become involved, or the cervix has been deeply attacked. If the disease have thus widely extended, if it have left the lips of the uterus laterally, or if it have passed upwards and induced thickening of adjacent structures, then the operation of excision is attended by great danger, and affords but little chance of benefit. Hence it follows that suitable cases for operation are very rare.

It is not by any means an easy matter in many cases to make a confident differential diagnosis between a simple or venereal ulceration of the os uteri and one of a malignant nature in an early stage. The tendency of the latter to bleed, its warty and thickened edges, and fœtid discharge, are the chief symptoms on which to rely. The surgeon must notice especially whether there be any tendency to new growth, and, if practicable, a small portion of the edge should be removed for microscopic examination. Pain, if severe, is a very suspicious sign. That old syphilitic ulcers may occasionally assume a cancerous action, there is good reason for believing. If doubt be felt, it should, if possible, be removed at once, either by consultation with others, or by resort to the microscope; for if the disease be in a stage permitting of removal, it should on no account be allowed further time for extension.

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* 'Though for the past twelve years I have been constantly looking out for cases suitable for it, but one instance has come under my observation, in which my surgical colleagues have considered it justifiable, and two or three more in which, in my own opinion, it might have been attempted.' Dr. West's *Lectures*, p. 413.

With regard to the diagnosis from each other of the different varities of malignant disease met with in this locality, no practical benefit can be got from its detailed consideration here. With respect to them all, the question of surgical importance is more as to extent than kind. All, if limited to the lips of the uterus, and if the latter organ be unenlarged and quite movable, should be either removed by operation or destroyed by caustics. If neither of these procedures are appropriate, the only resource left is palliative treatment—the mitigation of pain; the restraining of hæmorrhages, and the lessening of discharge and fœtor. Opium, rest in the recumbent posture, and the use of detergent injections (arsenic, Condy's fluid, chloride of zinc, and the like) are the means by which these indications are to be attained. The prognosis of malignant disease of the uterus, despite all that can be done by art to diminish the sufferings which lead on to the inevitable result, is most gloomy. The fact that a most painful and protracted death is the other alternative ought certainly to be allowed its due weight in inciting us to energy in the treatment of any cases which come under observation in an early stage, and may even justify resort to measures not by any means free from immediate risk.

I shall probably be excused for not entering here into any examination of the operation for extirpation of the whole uterus when affected by cancer. That, excepting in very rare instances of complete procidentia, it is not justifiable, is admitted by all. Dr. West, who has carefully collected the statistics concerning it, informs us that of a total 'of 25 cases, 22 terminated fatally in consequence of the operation,' and but 3 recovered. Of the three latter, 'two months, four months, and one year were the periods during which the patients respectively survived.'

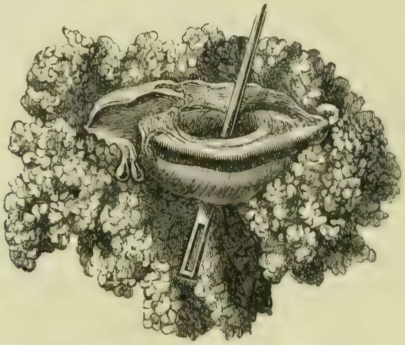
Excision of cancerous ulcers affecting the lips of the uterus (or amputation through its cervix) is an operation of a very different character, and in well-selected cases not attended by any large amount of risk. Its introduction dates from the earliest years of the present century, when it was largely employed by Osiander of Gôttingen and subsequently by Lisfranc of Paris. Unfortunately, for reasons which we need not state, the large statistics brought forward by the latter surgeon are utterly without value. In this country it has not been very largely adopted, although many surgeons have performed it in isolated cases. Sir James Simpson has probably had the largest experience of any British Surgeon respecting it.

Mode of performance.—The patient should be placed in the lithotomy position, and the thighs well separated. The vagina being opened by the duck-billed spatula,—or, if requisite, by a bivalve speculum,—the cervix should be securely seized by long toothed-forceps or Museux-hooks, and steadily but gently dragged downwards. At this stage it is a good precaution to transfix it laterally, above where it is intended to cut, by a needle armed with a wire ligature, the latter to be retained. The uterus having been brought as low as possible, the incisions are to be commenced below, at a suitable distance from the diseased structures, and carried from behind inwards and upwards; then a similar incision is made in front, and carried inwards and backwards so as to cut out a conical portion. In this incision either scissors or knife may be employed; if the latter, it should have a rounded point. After the section, by means of the wire previously inserted, the stump may be still held in view, both to permit of examination as to whether the disease has been completely removed, and of the application of escharotics, should the hæmorrhage make them desirable. The advantage of beginning at the lowest part is, that the blood does not conceal the surface where the next incisions are to be made. It is one of those operations in which the plan of constant irrigation during its performance may be adopted with advantage. The actual cautery and the perchloride of iron ought to be at hand, in case their application may be required. As hæmorrhage may chance to recur some hours afterwards, it is desirable to retain hold of the stump by leaving the wire in, or the latter may be made use of to tie a compress of lint over the bleeding surface.

With the precaution above described the operation of excision by cutting instruments is probably safer and preferable every way to that by the écraseur. With the latter instrument the surgeon is not able to adapt his line of incision accurately; the chain must pass horizontally across the entire cervix, and, in order to be sufficiently above the disease at one part, it may be needful to take much more than is necessary at the opposite side. This would be of minor importance if it did not involve more or less risk of including a portion of the peritoneal pouches, which have been drawn down by the back and front parts of the cervix.* It is impracticable with the écraseur to remove a conical portion, as advised above; and lastly, although this instrument obviates to a great extent the danger from hæmorrhage, it probably increases those from peritonitis and pyæmia. It is for cases of long cervix that the écraseur is especially adapted, and precisely in the same is direct excision easy and safe.†

After the amputation of the cervix uteri, whether by scissors or écraseur, the patient should be carefully and unremittingly watched for twenty-four hours. In addition to the risk that bleeding may occur, it is possible that a peculiar form of collapse (abdominal collapse of Dr. Barnes) may supervene. Simpson records two such cases, one of which proved immediately fatal, there having been no hæmorrhage or other cause adequate to explain it.

Fig. 312.



Copied from Sir James Simpson's *Obstetric Works*, vol. i. p. 164. The woodcut represents a cauliflower excrescence excised in the case referred to in the text.

For reasons already hinted at, it is almost impossible to obtain any trustworthy data, either as to the immediate risks of the operation or the average duration of life in successful cases after it. Simpson records in detail one case in which he excised a large epithelial cancer (cauliflower excrescence), and the woman at the date of his lecture, (eighteen years after the operation), was still in good health, having borne several children in the interval. He seems to be, on the whole, very favourably impressed as to the value of the operation; but he abstains from furnishing any numerical data as to the results he has obtained.* With the exception of two or three cases in

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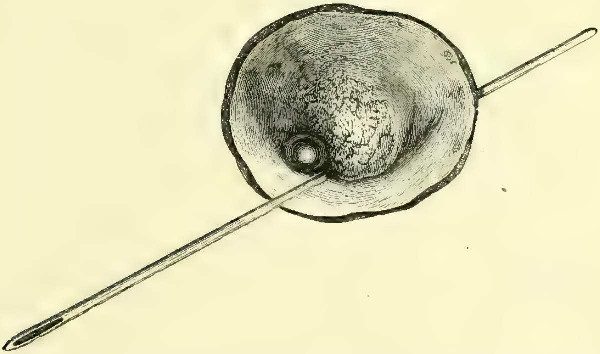
* This risk is not imaginary. I am acquainted with a case in which a considerable portion of the peritoneum was thus removed. Others are also on record. See Simpson's Lectures in the *Medical Times and Gazette*, vol. xviii. p. 105, and Dr. West, op. cit. p. 416.

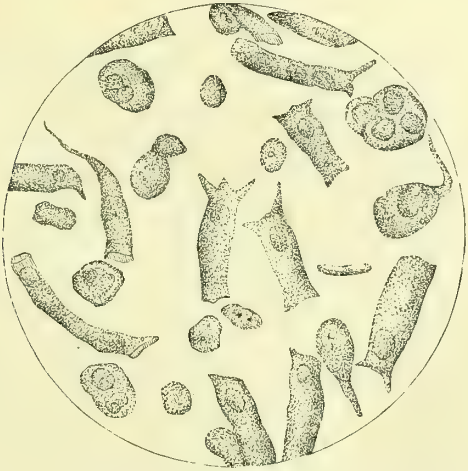
† If the écraseur be used, an instrument with a curved end will be found more convenient than a straight one. A strand of twisted wire, as recommended by Simpson, will be better than a chain.

Fig. 313.



Nodule of cancer in the scar left by an excision of the os uteri six months previously. The woodcut shows the exact size of the portion removed at the second operation. The probe is passed up the canal of the cervix. From a case recorded by the writer in the *Path. Trans.*, vol. viii. p. 253.

Fig. 314.



Cell structures from the nodule, showing altered forms of columnar and ciliated epithelium.

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* The following extracts from his lecture are of much interest: 'I never saw a case which proved fatal by bleeding, or even one where hæmorrhage

Guy's Hospital, the operation has not, I believe, been performed of late years in any of our larger London hospitals. The Guy's cases were, I believe, all successful, but productive only of temporary benefit.

If the case be one in which the surgeon has any choice as to performance of excision, he will probably do well to prefer it to the use of escharotics. There are certain cases, however, in which the disease extends too deeply for a safe excision, where it may yet be fair to employ the former. The best for the purpose is probably the dried sulphate of zinc, as advised by Sir James Simpson. It may be applied either in powder, by aid of a speculum, or made up into a pessary by means of ointment. Some carbonate of soda, in the form of a pessary, should be introduced into the vagina, to neutralize the zinc in case it should run. The potassa fusa is not manageable; but the chloride of zinc may, with care, be conveniently used. The actual cautery is, however, perhaps as efficient, as free from risk, and as little painful as any, especially when heated by the aid of galvanism. In many cases in which escharotics have not effected a cure, the patient has yet been fully compensated for the pain incurred, by the temporary alleviation of symptoms which resulted.

VI. Malignant Disease of the External Genitals.

The chief form of malignant disease by which the external genitals of the female are attacked is epithelial cancer. With the epithelial disease, there may in some cases be a certain amount of melanotic growth interspersed, or the disease may even begin in a mole, and be chiefly of the latter character. In females of middle age epithelial cancer of the labia, or adjacent parts, is by no means infrequent. The disease presents the same characters as in other parts. An irregular, undermined indurated edge, an unhealthy gray surface, and a tendency to the production of warty granulations, are its chief features. It is a most formidable disease. Absorption from these parts is usually very rapid: the glands in the groin become contaminated with startling rapidity; and the surgeon's function is then for the most part restricted to attempts at alleviation. In

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occurred in any alarming degree.' 'Let me lastly observe, that some patients, but not very many, have died of peritonitis, or that form of surgical fever,' &c.

all the cases, with the subsequent history of which I am acquainted, the result has been a speedy recurrence. In two of my own it was needful to remove also diseased glands from the groin.

Like epithelial cancer of the penis, scrotum, &c. in the male, it is chiefly met with in middle-aged or elderly persons; but may occasionally be found in younger women. Not unfrequently when it occurs to young adults, it attacks a sore which was in the first instance venereal. This fact must be kept in mind in practice, or an error in diagnosis may result. The one point in respect to the hopeful treatment of epithelial cancer is its early recognition.

Considerable differences are observed in different cases of cancer of the female genitals. In some the course of the disease is very rapid, in others much slower. I believe it will usually be noticed that when the ulcer began on the mucous surface it has been rapid in progress, and that when in the skin it has been more slow.

Although, as above stated, it is extremely prone to recur after excision, yet, as we possess no other remedy, there can be no doubt that, wherever practicable, the diseased part should be freely removed, or destroyed by caustic. In most cases the knife is probably preferable. If the inguinal glands are at all enlarged, such as are so should be removed also. These operations are rarely dangerous to life, and usually the patient's sufferings are wholly relieved for the time; often a few months of enjoyable life are obtained before the disease recurs. Since, therefore, in almost all instances they give relief for a longer or shorter period, while there is always a chance that a cure may be obtained, it is without doubt the surgeon's duty to give his patient the benefit offered whenever practicable. If the disease recur, a second period of health and freedom from suffering may be obtained by a second use of the knife. Whether the operation be a primary or a secondary one, it is impossible to exaggerate the importance of doing it early. It is only in the early cases that there is any chance of a permanent cure.

Respecting the Rodent Ulcer, little need here be said. It is very rarely met with on the female genitals. I think I have seen one undoubted example of it. It is distinguished from epithelial cancer by the absence of warty growth, by its slow progress, and by its never causing the lymphatic glands to enlarge. It should always be excised where practicable. The diagnosis will usually rest between it and sores of tertiary syphilitic origin.

VII. Non-malignant Diseases of the External Genitals.

The diseases of an innocent nature to which the external genitals of the female are liable will chiefly find place in connection with other subjects. Thus the induration and enlargement of the labia, clitoris, &c. are most frequently forms of elephantiasis consequent on venereal affections. It may be convenient, however, to remark here, respecting the removal of these enlargements, that they may for the most part be undertaken with perfect safety. Hypertropies of the labia commence usually in inflammatory œdema, produced by the irritation of gonorrhœal discharge, or of mucous tubercles; but when they have advanced to a certain extent, they tend to increase, in consequence of the mechanical impediments to a normal state of circulation presented by their pendent position, and without any reference to their original cause. It is therefore desirable that they should be removed early. When very large, the risk of very profuse hæmorrhage is considerable. The bleeding is usually from a multitude of small vessels, not from any single one of considerable size. A good precaution against hæmorrhage is to transfix the base of the pendulous mass by means of harelip-pins before using the knife. Over these pins twisted ligatures may be applied, so as tightly to compress the divided structures and arrest all bleeding. Of course all vessels that can be tied separately should be secured previously to the application of the twisted sutures. On several occasions I have found the latter the only means by which the continued draining from small vessels could be stopped.

These tumours consist only of hypertrophied cutaneous structures, and may be developed to a very large size, if not removed in anticipation. They may involve one or both labia, the clitoris, or any part of the immediately adjacent integument. It is sometimes needful to bear in mind that their subjects have often also suffered from constitutional syphilis, since, in the after-treatment of the wound, specific remedies may become necessary.

Cystic tumours may be met with occasionally in the subcutaneous tissues of the female genitals. The most common are those formed in connection with the Cowperian glands. They are to be found about an inch or an inch and a half within the vulva, and placed a little below the middle of one or other side of the vagina. They are usually somewhat movable, and non-adherent to the mucous membrane; often very tender to the touch; and rarely larger than a chestnut. When opened, a glairy mucus escapes, often of fœtid odour. Their mucous contents may be mixed in greater or less degree with inflammatory products; and sometimes acute inflammation has occurred and dirty grumous pus, of most fœtid smell, is the product. For all these conditions the simple measure of treatment is to lay them freely open, and to introduce lint, to prevent premature closure of the orifice. They are more common in young women than in those of more advanced age, and are not unfrequently met with soon after marriage.

In rare instances cystic tumours of much larger size than those developed from inflammation of Cowper's glands occur beneath the labia. These sometimes possess a smooth lining-membrane, which it is desirable to dissect cleanly out, in order to prevent refilling. Their contents are usually glairy, indicating that the starting point was from a follicle or mucous gland. There is almost always the history of long duration. An entire absence of inflammatory irritation has usually been the reason for their being allowed to attain to an inconvenient size before surgical advice has been sought. In undertaking the removal of these cysts, the surgeon must always be prepared for free hæmorrhage, owing to the highly vascular endowments of the parts.

VIII. SURGICAL MEASURES IN EXTRA-UTERINE PREGNANCY.

A large majority of extra-uterine pregnancies end in death from internal hæmorrhage within a few months from the date of conception. In some instances, however, the fœtus perishes at an early period without rupture of its investments; and in these, without causing any ill consequences at the time of its death, it may subsequently remain, for indefinite periods, as an encapsuled mass within the maternal organism. In a smaller group of cases neither of these events happens; but the life and growth of the fœtus are prolonged to the full period of gestation at or about which time, however, it inevitably dies. It is these latter cases chiefly which are likely to become of interest to the practical surgeon.

In a case in which an extra-uterine fœtus has died at the full period of gestation, and remains lodged in its mother's abdomen, several events may ensue. The fœtus may, in the first place, remain without causing irritation, may gradually diminish in bulk, and having been converted into a mass of adipocere, be carried without material inconvenience to the end of a long life. Many instances are on record in which this has been the course of events, and there is abundant proof that a woman may, even without detriment, pass through repeated pregnancies, with an encysted extra-uterine child still lodged within her. The second possible course is, that the fœtus may set up irritation, induce suppuration, and cause ulceration, either through the abdominal wall, or into the vagina or rectum; and that thus a process of natural expulsion may be accomplished. A third event, which, like both the preceding, is exemplified in many recorded cases, is that the fœtus may cause such an amount of constitutional disturbance as will be fatal to the mother before there has been time for any process of expulsion to take place.

The questions, therefore, on which a surgeon, who is called upon to decide as to the treatment to be adopted in a case of this kind, will require information, are:*

1st. What is the probability as to the fœtus remaining in a quiescent state, should the case be left to nature?

2nd. What is the amount of risk that extreme, or even fatal, constitutional irritation may be set up?

3rd. If the fœtus set up inflammation, and a process of spontaneous expulsion be commenced, what is the prospect as to the mother's surviving it, and what may be expected to be the amount of suffering through which she will probably have to pass?

4th. Should the surgeon decide to remove the fœtus by an immediate operation, what is the degree of risk attending such a procedure?

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* I have said nothing in respect to the diagnosis, since it is usually not difficult. It may be well to insist on the necessity for great caution before resorting to any operative measures. This caution is especially needful in regard to the subjective evidence furnished by the patient. In one case, in which Dieffenbach was the operator, and the measure was resorted to under the sanction of Dr. Heim, no fœtus was found, and the abdomen was again closed without removing anything. Fortunately in this case the woman recovered. At p. 58 of the *Medical Times and Gazette* for July 1860 is the narrative of a case in which the history might very easily have misled. The surgeon must rely almost solely on the evidence afforded by manipulation, &c. of the supposed tumour.

5th. Supposing the case to be for the present left to itself, will there occur, at any subsequent time, a suitable occasion for the removal of the fœtus after symptoms of irritation have commenced?

To enable us to reply to the above questions, a very considerable array of cases may be collected, and they are of a character in respect to which the evidence afforded by well-judged statistics may become exceedingly valuable. It is not compatible with the space permitted by the present work to cite the cases themselves; and I am obliged, therefore, to refer the reader who may wish to investigate them more minutely, either to the excellent monograph of Dr. Campbell, or to a series of reports compiled by myself (in large measure from Dr. Campbell's book) and published in the *Medical Times and Gazette* for July and August 1860. In the reports in question, I carefully collected all the cases I could find published, amounting in total to no fewer than 102. These may be conveniently grouped under the following heads:—

Group A. Cases in which the fœtus was retained in a quiescent state in the mother's abdomen to the end of her life.—In this group we have twenty-one cases. In three or four instances living children had subsequently been born. The shortest period of the mother's life after the death of the fœtus was four years, the longest fifty-six years. A very much larger number of cases are on record, in which the remains of extra-uterine conceptions were retained for long periods without inconvenience. In most of these, however, there is reason to believe that the fœtus had not nearly attained its full growth, and they have therefore been excluded.

Group B. Cases in which, without any operation, the fœtus set up irritation, and caused the mother's death.—This group is a very important one, since it contains those in which the natural processes were neither interfered with nor assisted, and in which they proved incompetent to the preservation of the mother's life. In not a few of them it is probable that surgical interference at the proper juncture would have saved the patient. In this class we have thirteen cases. In some, death occurred either during the symptoms of false labour, which usually occur at the time the fœtus dies, and last a few days or a week, or within a short period afterwards. In others the mother lived for a few months after the death of the fœtus, and in one for as long as two years and seven months. In none of the cases counted in this group had any abscess given way externally, but in several inflammation of the sac had occurred, which would no doubt, had the patient lived longer, have terminated in ulceration, and an attempt at spontaneous expulsion. The lesson of these thirteen cases seems strongly in favour of interference.

Group C. Cases in which ulceration through the abdominal wall took place, followed by escape of the fœtus.—We have in this twenty-nine cases, in fourteen of which no surgical interference took place; whilst in fifteen, subsequent to the abscess having given way, an incision was practised, and the fœtal remains extracted by the hand. It will be convenient to call this latter procedure *secondary* abdominal section, to distinguish it from *primary* abdominal section, by which we denote an operation performed prior to the occurrence of abscess. Of the fourteen cases in which nature did all, eleven recovered, and two died; the result in one not being known. Of the fifteen in which secondary abdominal section was performed, in one the result is not known, and of the others all but one recovered. The cases in the next group differ only from these in regard to the position in which the abscess gave way.

Group D. Cases in which ulceration into the vagina or rectum occurred, followed by expulsion of fœtal remains.—In several of these, more or less of surgical assistance was afforded in the extraction of bones, &c., as they were protruded from the cyst into the cavity involved. The group comprises twenty-three cases, of which only three ended fatally.

There now remain for consideration only the last and very important group of cases, in which the surgeon interfered early, abdominal section being performed before abscess had occurred. In some of these the operation was performed during inflammation of the cyst, and when the patient's constitutional symptoms required that something should be done for her relief; in others it was adopted when all was for the present quiet, and with the object of ridding the patient of a burden, or of preventing possible mischief in future.

Group E. Cases in which primary abdominal section was performed.—In this group we find sixteen cases; out of which six resulted in recovery, and nine in death.

Keeping our attention strictly confined to the question as to the propriety of surgical treatment in these cases, it will be seen that the facts just adduced afford us most valuable guidance. The facts in favour of *secondary* abdominal section are conclusive. No one can doubt that in cases in which processes of suppuration and ulceration have already been set up, it is the surgeon's province to assist in the removal of the decomposing body. The chief point in debate is, therefore, in respect to those cases in which as yet no symptoms have been induced. Let us suppose a woman in perfect health with an extra-uterine fœtus of full growth, and dead, retained in her abdomen. She has probably passed the date at which labour was expected by several months, and is quite free from all uterine disturbance; her menstruation being again regularly established. Ought the surgeon, in such a case, to perform *primary* abdominal section; or ought he to advise the patient to let present well alone, and not submit to operative interference until it should become needful? On the one hand is the fact that a large number of cases similar to our supposed one have been followed by no ill consequences whatever, and that their subjects have lived to old age, in some instances becoming the mothers of living children; on the other hand, we have seen that, in a considerable majority of cases, the retained fœtus does sooner or later set up irritation, and, in not a few, of such a severe character as to cause the death of the mother. If no opportunity for surgical interference were likely to occur again, there might be valid reason for urging the immediate operation. But the fact is, as I have shown, that while primary abdominal sections are very fatal, those performed subsequent to spontaneous inflammation are followed by a large proportion of recoveries. The difference between the two operations is very great indeed. In the one, in all probability, a healthy peritoneal sac is laid open; whilst in the other, adhesions having formed, the incision amounts to little more than opening a large abscess. After the one, the decomposing débris of the placenta, the fœtid pus, &c., will have access to the peritoneal sac; whilst in the other they are wholly shut off by adhesions. In the one, a healthy woman is subjected to all the dangers of a sudden and most severe operation, for which her system has been in nowise prepared; in the other, a source of irritation is removed from the organism at the very time when it is becoming felt to a degree almost incompatible with the continuance of life. Whoever shall carefully examine the cases to which I have referred will, I think, come to the conclusion that the longer the interval allowed to elapse between the death of the fœtus and the operation for its removal, the less the danger of the latter. Dr. Campbell regards the operation as not advisable until after 'the system of the parent has been restored to its unimpregnated condition, and nature has evinced a disposition to remove the extraneous mass.' The difference in risk at different times has, however, in all probability much more to do with the state of the peritoneal sac as regards adhesions than with any other condition. The longer the operation is deferred, and the more prolonged the inflammation, the greater is the probability that efficient adhesions will have formed.

As regards the operation itself, little need be said. The tumour should be opened over its most prominent part, and sufficiently freely to allow of the introduction of the hand. Unless the placenta be found detached, it ought not to be removed, but left to come away afterwards. The attempt to detach it might very possibly tear through the cyst, and open into the peritoneal cavity. If no adhesions between the cyst and the parietes be found, the opening in the former should be brought well forward into the wound, and then secured by sutures. The after-treatment should be conducted on general principles.

IX. Operations for Rupture of the Perinæum and its Consequences.

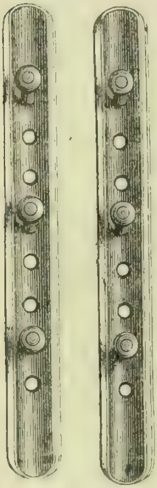
Rupture of the perinæum occurring during the passage of the fœtal head may vary very greatly in its extent. If it involve only a limited extent of the anterior edge, it is of little consequence, and may be disregarded. If, however, it extend backwards through almost the entire length of the structure, there will be great risk that if nothing be done the patient will hereafter suffer from prolapsus of one or other of the pelvic viscera. In a still more severe class of cases, the sphincter of the bowel is also torn through, with the result of incontinence of fæces. In all cases except those first mentioned, in which the laceration is trivial, it is very desirable that the rent should be closed. Should opportunity occur immediately after delivery, it cannot be done too early. The edges of the tear should be well cleansed, and secured firmly in apposition by deep sutures in the manner about to be described. It is quite possible that the bruised condition of the parts, the presence of lochial discharge, and the state of the patient's health, may interfere with union; but even should they altogether prevent it, nothing will have been lost by the attempt.

Should no operation have been performed immediately after the accident, or should it have failed to secure union, the patient will probably come under care subsequently, suffering either from prolapsus or inability to retain her fæces, or from both. Whether the sphincter ani have been torn or not, signifies but little as regards the operation to be performed. It is remarkable that it is as easy to procure union in the more severe as in the slighter cases, and the mode of operating is very similar in both. With regard to the relief of the two classes of symptoms, however, it is widely different. If the sphincter ani have been torn through, the patient may be safely promised that an operation for the restoration of the perinæum will be effectual in giving her full control over the lower bowel; but it is impossible to speak so confidently as regards the lesser evil of prolapsus. With respect to the degree of advantage to be expected as to the prolapse, the reports of those who have tried these operations vary considerably. Those who appear to have examined the matter most candidly, confess that in not a few cases considerable disappointment followed; and that although benefited for a time, the prolapse subsequently returned. We can have little difficulty in understanding this, if we bear in mind that the severest forms of prolapsus, whether of uterus, rectum, or bladder, are quite compatible with perfect integrity of the perinæum. Other causes besides want of support below, usually conduce to the descent of the viscera into the vulva. Still there can be no doubt whatever in the minds of those who have seen much of these cases that loss of the perinæum favours prolapse, and that its restoration does much to obviate it. With regard to the degree of benefit obtained, much will depend upon the mode of operating. If, as in several cases on record, the operator contents himself with simply denuding a narrow strip on each side the vulva, and uniting the parts across, a thin perinæum, consisting of little more than integument, will be the result; and the most that can be expected will be, that what was complete prolapsus may subsequently not amount to more than procidentia. If, on the other hand, the denudation be carried high up into the vagina, and the parts carefully united very deeply, the lower two inches of the canal may be very greatly narrowed, and a very effectual impediment to the descent of the viscera afforded. Although operations with this object have been performed in England during the last few years by many surgeons, and with considerable frequency, yet but few data are on record by which to estimate the ultimate benefits. I may therefore, perhaps, be excused for referring to my own individual and but limited experience.

Including three cases in which the sphincter ani was also torn through, my operations for restoration of the perinæum, in order to obviate prolapse, have been ten in number. In none did any untoward results occur; but in one no union was obtained. In two or three, to my knowledge, the patients suffered from procidentia more or less during subsequent years. In three others I lost sight of the patients within a few months of the operation, there having been no relapse whilst they remained under observation. In three I can speak confidently as to the permanency of the relief afforded, since I had opportunities of examining the patients several years afterwards. In one instance the patient, an elderly woman, who before the operation suffered from complete prolapsus in a most distressing form, the uterus being swollen and deeply ulcerated, received most signal benefit. I examined her repeatedly during the two years following, and always found the uterus high up in the vagina. She lived six years afterwards; and I was assured by her daughter that up to the time of her death she had remained quite free from her old malady.

The operation for making a new perinæum is conducted on the same plan whether the sphincter ani be torn through or not. The cicatrised edges of the laceration are to be freely denuded, and the parts united by deep quill-sutures. The sutures may be tied over a piece of quill, a rod of glass, a piece of bougie, or, what I prefer most, a perforated metal bar. I have used those figured in the woodcut in several cases, and found them exceedingly convenient. The wires are brought through the holes and then twisted round the little pegs. This allows of any single wire which may appear to be either not tight enough, or too tight, being readjusted with great ease.

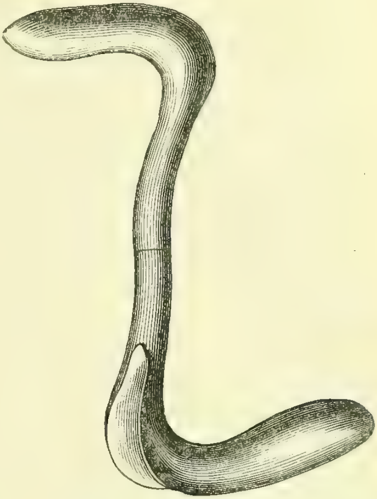
FIG. 315.



Perforated metal splints, for use in the operation for ruptured perinæum.

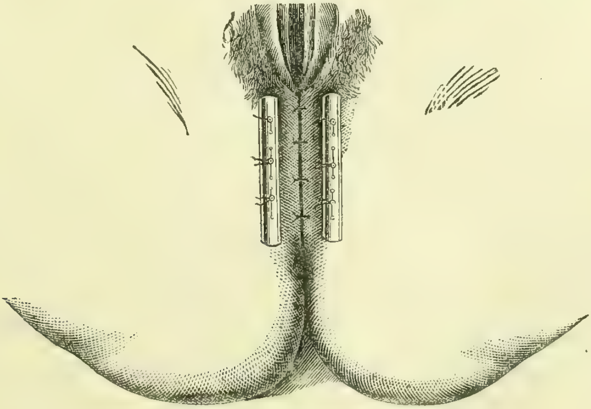
During the operation the patient should be under the influence of chloroform, and in the lithotomy position. The vagina should be well opened by means of the duck-billed speculum, and a plentiful supply of ice should be at hand to arrest the bleeding. It is desirable to denude extensively, both as regards the length and the thickness of the new perinæum. Very much, as to the degree of relief to the prolapsus, will depend upon whether a good thick cushion is obtained or only a thin cutaneous one. It is desirable also to narrow the vagina for some distance. These important ends are best secured by dissecting up the mucous membrane of the vagina, posteriorly and laterally, for a considerable length upwards. Immediately in front of the rectum the denudation should extend an inch and a half upwards, and from this point it may slant laterally on each side, downwards and forwards, to the point selected as the front edge of the new structure. The dissection should begin from below. Instead of cutting away the flap of mucous membrane, I much prefer to adopt a plan somewhat similar to that of Fricke. The mucous membrane is turned upwards into the vagina, and the deep sutures are passed, the one nearest to the rectum being introduced into the full depth of the denuded tract, *i.e.* an inch and a half from the orifice. The other sutures will pass to less depths, the most anterior one being the shallowest. The flap of mucous membrane is now freely trimmed at its sides, and is united by wire sutures to

Fig. 316.



A modified duck-bill speculum: the most convenient form for vaginal operations. (Pratt's modification of Sims'.)

Fig. 317.



The perinæum after coaptation by deep sutures, &c.

the anterior edges of the new perinæum. It thus slopes forward, covering over the deep surface of the newly-united parts and extending their whole length. This flap is nourished by its attachment above to the vagina, and, according to my experience, there is no risk of its sloughing. I believe that it materially favours union by preventing vaginal discharges from gravitating into the wound; and it also greatly thickens and strengthens the new perinæum. Of course, when the rectum is torn high up, a central flap cannot be obtained; but I should still, in these cases, incline to save as much as possible of the lateral ones. The parts should not be closed until the bleeding, which is often rather free, has a good deal diminished. A recurrence of hæmorrhage within a few hours of the operation is not very unusual; and, with a view to its prevention, it is well to leave a fragment of ice in the vagina, and to apply an ice-bladder externally. Some operators have insisted strongly on the importance of freely dividing the sphincter ani; and in cases in which the laceration extends high into the bowel, this measure is undoubtedly important. In cases in which the sphincter has not been torn, it is certainly unnecessary to divide it; and even in some in which it has been so, excellent results may be obtained without.

In the after-treatment the bladder should be kept empty and the bowels confined. The sutures should not be removed until the sixth or seventh day, and, however favourable the result, the patient should be made to keep her bed for at least three weeks.

The recumbent posture made necessary by the operation is, no doubt, an important part in the cure of the prolapsus for which the operation is often performed. It allows time for a swollen and, perhaps, ulcerated uterus to diminish in bulk and weight, and for its stretched ligaments to shorten.

X. Organic Diseases of the Ovary.

When we consider the peculiar function of the ovary, and the irregular demands which are made upon its activity, it is not surprising that it should frequently become the seat of disease. Restricting our attention in this essay to its organic affections only, we may classify these in two groups—the solid and cystic growths.

The *solid growths* met with in the ovary are, first, fibroid tumours, and second, malignant tumours. The fibrous tumours are decidedly rare. They may in some instances attain very considerable size, and may even approach that of a pregnant uterus; more usually they are much smaller. Their substance is made up of dense fibrous tissue, which replaces the stroma of the organ, and by which the latter is at length wholly substituted. During life it would be difficult to diagnose with any certainty between a fibroid tumour of the ovary and a similar growth from the uterus (if detached and pedunculated); but as the rule of treatment is the same for both, but little practical importance attaches to the question. In both it is desirable to give a fair trial to the bromide or iodide of potassium, or to some natural water holding haloid salts in solution (Kreuznach, &c.). These salts are to be recommended, not so much in the hope of inducing any absorption of the tumour, as of repressing its vitality and arresting its further growth. Solid tumours occupying the abdomen, whether originating from the ovary or the uterus, and whether believed to be innocent or malignant, should not be interfered with surgically. If innocent, they rarely cause death, and at a certain period of life almost always begin to shrink; whilst any attempt to remove them by abdominal section is attended by great danger.* If malignant (*i.e.* medullary), the reasons against their removal, or rather against the attempt at it, are manifold and apparent. The form of cancer (very doubtfully such) most frequent in the ovary is that known as alveolar, or colloid, and the tumour thus constituted is cystic rather than solid. In rare instances, however, medullary cancer occurs as a primary disease in the ovary, and a very large tumour may be thus developed.

Cysts in the broad ligament.—These very rarely attain any large size. They are not unfrequently met with in infants, but are rare in adults. They are supposed to be consequent on cystic dilatation of the tubes of the Woolfian body. They have but little surgical interest, since they rarely attain a size sufficient to call for treatment, or even to be discovered during the life of their possessor.†

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* In these remarks it is intended to include only those tumours which have passed upwards into the abdominal cavity and become pedunculated. Uterine fibroids still occupying the walls of the uterus are treated of elsewhere (see p. 14). It must be always remembered that the dangers of abdominal section for solid tumours far exceed those of ovariotomy. As the tumour cannot be diminished by tapping, the incision must be very free, whilst the peduncle, if it exist, is certain to be short thick, and very vascular.

† There is no doubt that occasionally cysts of the broad ligament attain

Cystic disease of the ovary.—This disease may present itself in two forms, either as *simple* or *proliferous* cysts ; but the two are very closely allied, and the former may at any time assume the characters of the latter. Again, we must note that the proliferous or compound cysts differ much amongst themselves in the degrees in which their peculiar endowment is developed. Some show but little tendency to reproduction, whilst others exhibit the utmost activity. There is good reason for believing that the simple cysts of the ovary are developed by the dropsical dilatation of Graafian vesicles. Not unfrequently more than one is formed in the same ovary; and at later stages the partitions between them may be broken down, and a single irregularly-chambered cavity may result. Simple cysts may attain a very large size, but the compound ones, as a rule, exhibit greater activity of growth. The *compound* or proliferous ovarian cyst is by very far the most frequent form of ovarian dropsy, and is closely homologous to the cystic diseases of the breast and testis, allowance being made for the different structural peculiarities of these organs. It is probable that the morbid action usually commences in the stroma of the ovary, but it may in some instances originate in the Graafian vesicles. With regard to the contents of ovarian cysts, it may be stated to consist of an albuminous fluid of greater or less density. In simple cysts the fluid is usually thin, but in compound ones it varies from the consistence of a dilute solution of gum-arabic to that of stiff glue. In the latter it often varies very greatly in different cysts composing the same tumour. In colour it also presents great varieties, from a clear watery fluid to a dark tar-like one. It often contains sparkling scales of cholesterine in immense quantities. In rare instances ovarian cysts contain a sero-purulent fluid, or even pus. This is more common in simple than in compound cysts, and usually is a consequence

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much greater sizes than those mentioned by Dr. West. Many years ago, at St. George's Hospital, Mr. Cæsar Hawkins operated successfully by ovariotomy in a case in which he found the cyst in the ligament and not in the ovary. The specimen is kept in the St. George's Hospital Museum, series xiv. No. 134. The cyst contained nearly eighteen pints. The description in the catalogue does not appear to me to afford any conclusive evidence in favour of the opinion expressed that the cyst was not really ovarian. An undoubted example of broad ligament cyst, large enough to simulate ovarian dropsy, came under my own care two years since. In the performance of ovariotomy, I found that the cyst had absolutely no peduncle, but passed under the peritonæum in the iliac fossa. The ovary lay in it, and was quite healthy.

of inflammation after tapping. The term 'alveolar or colloid cancer,' has been applied to a not very infrequent variety of compound cyst of the ovary in which very numerous loculi exist, and the spaces are filled by a semi-solid tenacious substance resembling gum. This variety, however, not unfrequently complicates tumours in which many cysts contain fluid and resemble those of the common compound form. There is much reason to doubt whether the usual tendencies of true cancer are ever manifested by it. Again, we must note that compound ovarian cysts differ not only in respect to the density of the contents, but also in the thickness of the intervening solid substance. Müller has applied the designation of cysto-sarcoma to those in which the fibrous intercystic substance equals or exceeds in quantity the contained fluid. Here, again, however, all degrees may be observed in different tumours, and even in different parts of the same tumour, and we cannot therefore venture to separate abruptly ovarian cystic tumours into different classes. Good typical examples of all of them—*a*, the simple, single cyst; *b*, the simple but multiple cyst; *c*, the proliferous or compound cyst; *d*, the proliferous or compound cyst with colloid contents; *e*, the proliferous with large sarcomatous formation—may frequently be met with; but in a large majority of instances ovarian tumours share the characters of two or more of these varieties. The more active the proliferous tendency, the further the departure from simplicity of organisation, the more nearly does that tumour approach in its relations to malignancy. Whether, however, any form of ovarian tumour, excepting the fungoid (medullary), is truly cancerous in its tendencies, is a matter of much doubt, and practically all must be treated as if it were proved that they are not so.

There is yet another variety of ovarian cyst to be mentioned, that, namely, in which a structure resembling the cutaneous integument (both in structure and function) is formed. These, known as Dermoid Cysts, possess the power of producing in their lining membrane all the appendages of the skin—hair, teeth, &c.—and of excreting into their interior the ordinary secretions of that organ. Thus not unfrequently teeth, balls of hair, or large quantities of fat are found in them. That these structures are, in many instances, in no way connected with impregnation, and are also quite independent of any 'included fœtation,' is amply proved.

With regard to the relative frequency of the different forms of ovarian disease, Dr. West supplies us with the following data: of a total of sixty cases, forty-one recorded by Scanzoni and nineteen by himself, simple cysts occurred in fifteen; fat-cysts in one; compound cysts (with cysto-sarcomata) in twenty-three; colloid or alveolar in nineteen; cancer with cyst-formation in two.

It has been hastily assumed, from calculations based upon opinions formed during the life of the patient, and necessarily liable to error, that ovarian cysts more commonly affect the *right* organ than the *left*. Post mortem-examinations prove, however that the two ovaries are equally liable to disease. Dr. West concludes, from the examination of nineteen of his own cases, fifteen of Dr. R. Lee's, and forty-one of Scanzoni's, that in about one-third both organs are affected. A reasonable suspicion may, however, be entertained that this proportion is much higher than more extended data will show.

Ovarian disease may occur at any *age*, from infancy upwards. It is of tolerable frequency during the whole period of sexual activity, but most so during the letter half, *i.e.* from thirty to forty-five. It is very rare in childhood,* and decidedly infrequent after the complete cessation of the menstrual function. It is relatively more common in single than in married women, and of the latter a large number have either been sterile or have manifested but feeble fecundity. No trustworthy inference as to the probable nature of the tumour can be drawn from the age or sexual condition of the patient. Beyond the fact that it is often associated with sterility or a low rate of fecundity, nothing can be asserted as to the causes of ovarian disease. In a majority of cases it develops itself in those whose sexual functions, with this exception, have appeared to be in perfect health.

The *rate of growth* of ovarian tumours is subject to considerable variety. In the majority of cases, in from two to three years from the commencement, or at least from its first discovery, the tumour will have become large enough to fill the abdomen and produce inconvenience by pressure on the viscera. In many the rate of progress is much more rapid; in a few, and especially in the aged, it may be much slower. Beyond the stage described, we are not able easily to ascertain the average natural progress of ovarian tumours, since in a great majority of instances one or other mode of treatment is adopted as soon as the dropsy becomes a serious inconvenience. Such facts as are on record, however, do not encourage the hope that in patients under forty ovarian disease, not interfered with, may frequently be protracted over many years. As soon as the abdomen is distended, the patient's health begins to fail, the process of assimilation is interfered with, exercise is prevented, the demands of the tumour are a drain upon the patient's strength, and she becomes not slowly thinner and more feeble; the tumour still grows, the lower limbs become œdematous from pressure on the veins, the thorax (both ribs and diaphragm) is displaced upwards and fixed, rendering respiration difficult and incomplete;* the patient ceases to be able to lie down, and, after a most painful illness, death at length puts a period to her sufferings. That the latter stages of ovarian dropsy should be prolonged over months instead of weeks would be a matter of regret rather than congratulation. In addition to the ills above mentioned, intercurrent attacks of peritonitis are common in the course of ovarian dropsy, and not very unfrequently spontaneous inflammation of the interior of one of the cysts takes place. Either of these occurrences may very seriously reduce the health of the patient, and the latter may prove directly fatal.

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* Kiwisch alludes to a specimen of cystic disease of the ovary from a child aged one year. I have myself seen a large ovarian tumour in a girl of twelve.

Before proceeding to consider the different surgical measures by which relief may be afforded, we must refer to the possibility of *accidental or spontaneous cure.* It is probable that now and then an ovarian cyst may, without having ruptured, spontaneously cease to secrete, and become greatly diminished in size. This termination has, I think, been illustrated in one case under my own care; but there can be no doubt that it is an exceedingly rare one. The rupture of the cyst, either by violence or by ulceration, into an adjacent viscus is much more frequent, and numerous cases are on record in which cures have been brought about in this manner. Notwithstanding an occasional cure so produced, however, the internal rupture of an ovarian cyst is scarcely an event to be desired. In not a few the death of the patient is the immediate consequence, whilst in others recovery only results after severe peritonitis and a dangerous illness. It is of course only in cases of single cysts that any permanently satisfactory result is to be hoped for, and even in these the probability is great that after the rent has closed, re-secretion of the fluid will follow. If instead of rupture into the peritoneal sac, the tumour have ulcerated into the bowel or vagina, all the dangers incident to inflammation of the cyst-cavity will probably be encountered.

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* See plates, by Dr. Bright, in *Guy's Hospital Reports*, vol. ix., or in New Sydenham Society's reprint, p. 90, plate 33, and p. 122 plate 36.

We may, then, safely allege that ovarian dropsy is, as regards any probable process of natural and spontaneous relief, an incurable disease. Further than this, we may safely add that, putting aside certain exceptional cases met with chiefly in aged patients, it is a disease which, within from one to three years of its commencement, may be expected greatly to incapacitate its subject for the ordinary enjoyments of life, and at the end of one or two years more to end fatally, after extreme and protracted suffering. In this statement of clinical fact we have the measure of the value of surgical methods of relief. To these latter the reader's attention is now asked.

We have the time-honoured plan by *repeated tappings.* Paracentesis can be ranked only as a means of temporary relief, not as affording any probability of cure. On the contrary, there are reasons for thinking it probable that those cases in which it is practised end earlier than those in which it is refused. The operation itself is by no means devoid of danger. Attacks of fatal peritonitis after it are not very uncommon, nor is acute inflammation of the cyst itself a rare event. If the patient recover well from the operation, the drain upon her strength by the re-secretion of fluid which rapidly takes place is greater than would have occurred had the cyst been allowed to remain full, and a second operation becomes needful, to be followed at a still shorter interval by demand for a third. Whilst, therefore, it is fully granted that in certain cases this method results in great temporary relief to the patient, that it may enable a woman who had been wholly incapacitated to get about in comfort for a few weeks, or, it may be, for a few months, still there is, I think, as little doubt that it is in the long-run prejudicial to the prospect of life. We must also recollect that in numerous cases—those, for example, of multilocular tumours—in which no one cyst greatly predominates in size, paracentesis can do little or nothing even for the reduction of the patient's bulk.

Various means have been devised with the hope of securing *obliteration of the cyst-cavity after paracentesis.* Amongst the chief of these we have: 1st, the application of very firm pressure over the abdomen; 2nd, the exhibition of mercury; 3rd, the injection of iodine into the interior of the cyst; and, lastly, the attempt to establish fistulæ, by which the re-secreted fluid may drain away.

The idea of preventing the refilling of a cyst by sheer *mechanical compression*, from without, is not one, at first sight, likely to claim our approval. It is, moreover, impossible to compress an ovarian cyst above; and firm lateral support will very probably only cause greater inconvenience to respiration by compelling the cyst to bulge upwards. Although a few cases of supposed cures, under treatment by starch-bandage applied to the abdomen, combined with the free administration of mercury internally, are on record, yet the plan has, even by the confession of its advocates, enough of drawbacks to prevent its coming into use; and it is, I believe, at the present time not resorted to by any surgeons.

The establishment of *fistulous channels* communicating with the interior of the cyst may be effected either through the abdominal wall or into the vagina or rectum. After tapping the cyst a flexible catheter is passed through the canula, and, the latter having been withdrawn, is there retained. The disadvantages of this plan are such as to have led to its almost entire disuse. It is attended by great risk to life, probably not less than that attaching to ovariotomy. It attempts the obliteration of only one cyst; it is a long, painful, and exhausting method; and lastly, even when cure has been obtained, there is no certainty that it will prove permanent.

In some cases, instead of establishing a small fistula by means of a retained catheter, a large opening has been made into the cyst by incision, and the edges of it carefully secured to those of the wound in the integument. The drawbacks just enumerated will be found at least equally real in respect to this method also.

The plan which, next to that of the entire removal, seems to promise most as a means of radical cure, is that by *injection of iodine.* In a few cases of single cysts this method is certainly very useful, and with due caution is attended by but little risk. Still we must bear in mind that the dangers consequent on a mistake in the differential diagnosis between ascites and ovarian disease are much greater if iodine be injected than if ovariotomy be attempted. Such mistakes have occurred; and it is precisely in the cases most suitable (were the diagnosis correct) for injection treatment—those, namely, of thin-walled single cysts

—that the mistake is most likely to happen. Then, again, if the tumour be multilocular, it is exceedingly probable that the secondary cysts will be irritated by the inflammatory processes set up in the larger one. Even when the chief cyst has to all appearance been permanently obliterated, the surgeon can never feel confident that there may not be others left behind it, which, sooner or later, will enlarge. To these drawbacks we must add that, even in the most suitable cases, it is quite possible that the patient may be poisoned by the iodine, or may sink under the attack of cyst-inflammation which follows its use.

Premising that the injection method is only admissible in the case of tumours believed to be monocystic, it may be granted, I think, that it exposes the patient to less risk in the whole than does ovariotomy. In this class of cases it is probable that it will continue to be occasionally employed. There are several different methods in which it may be practised. Either the iodine may be diluted in a large quantity of water, or it may be employed in a concentrated solution. The former was the method recommended by its introducer, Boinet; the latter is the one which has of late been considered preferable. The free dilution of the fluid diminishes the caustic action of the iodine on the lining membrane of the cyst, whilst it much favours its absorption into the patient's blood. Even with the most careful endeavours to empty the cyst, there always must remain in its interior a certain quantity of fluid, quite sufficient to dilute the most concentrated injection which could be employed.

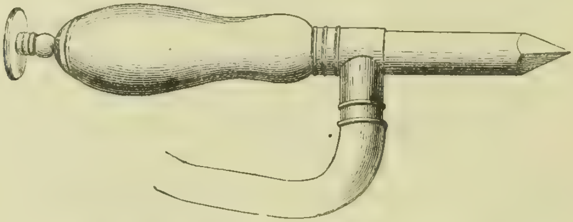
In performing injection the cyst-fluid should first be evacuated in the usual way, by paracentesis, the patient being on her side in bed. When the cyst is three parts emptied, a flexible catheter should be passed down the canula. This should be sufficiently large to fill the canula, and both should be retained. The cyst-fluid should be patiently allowed to drain away as completely as possible, the patient's posture being changed as may seem most suitable to this end. When no more fluid can be obtained, the iodine solution is to be injected, and, having been retained for ten minutes or a quarter of an hour, may be allowed again to drain out. Finally, the catheter and canula are to be withdrawn together, in doing which the surgeon must be very careful to have his finger over the end of the former, to prevent the escape of drops of iodine-fluid into the peritonæum, during the passage of the end of the instrument through the wound.

The after-treatment must consist in the use of ice, and of stimulants or opiates, according to the symptoms which may arise. If, in performing the preliminary paracentesis in a case in which it is intended to inject, the fluid should be found too thick readily to escape by the canula, this plan of treatment should, I think, be abandoned, since it is very probable that the tumour is polycystic; and even if not, the mere density of the fluid will very greatly prevent the efficiency of the injection.

Having thus briefly adverted to the less complete of the attempts at radical cure, we now come to what may be considered one of the boldest innovations of modern surgery,—*the practice of complete extirpation.* This method has the advantage over all others, that it holds out the hope of permanent cure without any danger of relapse, and that also it is equally well adapted to the multilocular as to the single cysts. In the majority of successful cases it has the further merit of causing to the patient remarkably little suffering. I think it may also be alleged in its favour that should an error have been made in diagnosis, less risk is run in an attempt at extirpation than would be by any one of the other radical methods. The large amount of immediate risk to life which attends this formidable operation is its one great drawback. Few practical questions have occupied more of the attention of the profession, both at home and abroad, during the last twenty years than this: whether the immediate risks of ovariotomy outweigh its advantages. Although many details as to modes of operating, &c., still remain to be decided, yet the verdict on the main question may be said to be given. The discussion has been carried on most openly; facts and statistics have been scrutinised most keenly; and the result is that ovariotomy is becoming more and more common; that it has recently been practised in almost every hospital in London, while it is gradually extending both in America and on the Continent. Simultaneously with the increased favour which ovariotomy has gained, the other methods of radical cure have fallen into comparative disuse. I shall not occupy space here with any attempt to enter into this discussion, but, venturing to assume that the operation does not now need any defence, shall proceed at once to consider the important practical details of its performance. First, let it be remarked that no impression can be more false than that the extirpation of an ovarian tumour is a procedure requiring but little surgical skill or forethought, and making demands only upon the surgeon's courage, or, it may be, in the estimation of some, his recklessness. Perhaps there is no operation in surgery presenting greater scope for ingenuity, and requiring more prompt attention to numerous details in its performance.

The operation.—In preparation for ovariotomy, the surgeon should be provided, in addition to scalpels, director, &c., with at least two large trocars, one of them armed with an india-rubber tube, two or three strong vulsellum forceps, two clamps, and actual cautery instruments, some gilt harelip-pins or silver-wire sutures, and strong hemp ligatures. Some strips of new flannel, and several large, unused sponges, made soft by scalding, should also be at hand. The operation should be performed in the room where the patient is to remain, and it should be a large and well-ventilated one. If the weather be not hot, the temperature of the room should be raised to 70° or 75°, and the air moistened with steam. With regard to special preparation of the patient, nothing is needful beyond the ascertaining that her bowels have been opened on the previous day, and that she is in usual health. It is especially desirable to abstain from disturbing her stomach by the previous administration of useless drugs. As the operation may be prolonged, she should be warmly clad on those parts which it will not be requisite to expose, and precautions should be taken to prevent her dress from being wetted by the fluid. Chloroform having been administered, an assistant should introduce a catheter and empty the bladder. The patient should be placed on her back with her shoulders elevated by pillows, her feet resting on a chair and the abdomen well exposed. The operator now commences his incision about two inches below the umbilicus, and

Fig. 318.



Trocar armed with tubing, for use in ovariotomy.

carries it downwards in the median line about four inches. With a few touches of the knife, and using the director or not, as may seem best to him, he rapidly divides the fascia and lays bare the peritonæum. There is rarely any bleeding if the median line be carefully kept to. The peritonæum having been opened to nearly the full extent of the wound, the cyst itself is exposed, and at the same time in many cases a certain amount of ascitic fluid escapes. The next step is to ascertain whether or not adhesions are present. This in many cases is evident to the eye; but if not, is easily determined by introducing one or two fingers between the cyst and the peritonæum. It is needful at this point to be exceedingly careful not to mistake the peritonæum itself for the cyst-wall, and thus carry the finger between it and the transversalis fascia—an error which has, to my knowledge, occurred several times, and to different operators. If adhesions exist, they must be cautiously broken down, and for this purpose it may be necessary to introduce the entire hand. For several reasons it is very desirable to break down all the adhesions, as far as practicable, before tapping the cyst. Whilst the cyst is full, it supports the parietal peritonæum, and prevents risk of its detachment by the traction necessary to tear them through: its pressure also diminishes the risk of bleeding. The operator—having ascertained that the cyst has no adhesion in front, or the adhesions, if present, having been broken through —next introduces a large trocar into the most prominent part of the cyst. At this juncture it is well to turn the patient partly on her side, unless a tube-armed canula be used. The best recipient for the fluid is a large glass funnel, fitted with india-rubber tubing. As the fluid escapes, the patient should be turned more and more over to her side, and her abdomen should be carefully compressed by assistants. When the tumour is three parts emptied, the operator may seize it with a vulsellum, and drag it forward carefully, at the same time attending to the trocar, that no fluid is allowed to run back on the wound. As the remaining fluid escapes, the cyst is gradually drawn out until it is wholly delivered; at which juncture the assistants should at once turn the patient again upon her back. A piece of flannel, from warm water, is now placed over the wound, the edges of which are held closely together by an assistant. The operator examines the pedicle, and determines as to the means by which to secure it; either the clamp or the ligature having been firmly applied, the bulk of the tumour is next cut away. It is well to cut it through at a distance of two or three inches from the seat of ligature, as by this means an effectual safeguard against slipping, and subsequent hæmorrhage, is obtained. With as little delay as possible, the external wound should now be closed; the surgeon having, however, previously, with his finger, ascertained the state of the other ovary. The wound may be closed either with harelip-pins or by strong wire sutures, and these may be introduced either through the entire abdominal wall, including the peritoneum, or through its whole thickness, with the exception of the latter. They should be an inch and a half from the edge of the incision on each side, so as to have a firm grasp. They should not be more than three-quarters of an inch apart, and great care should be taken to carry the lowest as close as possible to the peduncle, or it may be well even to transfix the latter. Should the clamp be used, its handles are now to be removed, the portion of peduncle left on is to be wrapped in lint, and the ends of the pins and those of the clamp are to be padded with lint. A large mass of cotton-wool may now be placed over the abdomen, and a four-tailed flannel bandage firmly applied over all. The patient should be returned to a warmed bed, and a suppository of two grains of opium may be introduced into the rectum. As a general rule, there will be no need for the administration of stimulants; but should the patient be faint, a little brandy may be given as an enema.

The *after-treatment* must vary according to the special symptoms which may present themselves; but we may venture to offer a few general suggestions. 1st. It is very desirable, in order to avoid vomiting, that the patient should take nothing by the mouth during the first twelve hours excepting a little ice; above all, no opium or other medicine should be so given. 2nd. There is reason to believe that the chance of recovery in many cases has been much diminished by the too hasty, and too free, resort to opium and stimulants. The surgeon should watch carefully, and give or withhold these remedies as the patient's state may demand. In not a few cases neither the one nor the other will be necessary. 3rd. If the patient be low, she should be nourished by enemata of milk, or beef-tea, to which, if needful, wine or brandy may be added. 4th. If the stomach remain irritable for some days, it is desirable, as long as such is the case, to continue the use of enemata instead of giving food by the mouth. 5th. It can scarcely be needful to insist that there should be a plentiful supply of fresh air to the sick-room.

Traumatic peritonitis is, without doubt, the chief cause of death after ovariotomy. It may commence within a few hours of the operation, and many patients sink from the shock of its initial stage. Many of the deaths attributed to 'exhaustion' have, in all probability, been really due to commencing peritonitis. In those cases which wholly escape peritonitis, the recovery is usually most rapid; the patient, in fact, scarcely experiencing a single ill symptom. The earliest *signs* of peritonitis are pricking and shooting pain in the abdomen, a peculiar pallor of the cheeks,* and an anxious expression of countenance, with frontal headache. The pulse becomes quicker and smaller, the skin hot, the tongue a little dry, and there is almost always more or less of sickness. Sometimes the patient scarcely complains of pain, excepting what is caused by the shake of vomiting. At a later stage the face may become flushed, and the skin pungently hot, whilst at the same time the pulse is rapid and very small. The concurrence of a very hot and dry skin, with a thready, scarcely perceptible pulse, may be observed now and then in severe cases and is a sign of most evil omen. Distension of the stomach with flatus is a common and distressing symptom, and at a later stage the intestines also become involved, and the abdomen is full and tympanitic. Peritonitis, after ovariotomy, may be either local or general. If it extend no further than the parts immediately adjacent to the pedicle and wound, it is protective rather than otherwise, since it tends to exclude irritating matters from the general cavity. In cases, however, in which the peritonitis is encysted, and involves but a small part of the sac, very profuse discharge may yet take place, and the patient may sink ultimately from exhaustion. If, in the first instance, the whole sac be involved, it is, I suspect, very unusual for any other than a rapidly fatal event to ensue. The *treatment* of peritonitis will be local and general. Locally it is well in the first instance, indeed as early as possible, to apply leeches freely, and these may be followed by a large hot poultice. The relief afforded by a large linseed poultice covering the whole abdomen is often very decided. On the other hand, the application of ice has its advocates, and it would not be difficult to explain how both heat and cold may each be beneficial. Venesection may in certain sthenic cases be resorted to with advantage. Opinions differ widely as to whether mercury is of benefit in traumatic inflammations; my own impression is very decidedly in its favour; and in early stages of the disease I should be inclined to push it freely, in combination with full doses of opium. The practice, too often pursued, of pouring in stimulants, is not, I think one to be recommended, either on theoretic or clinical grounds; but the patient must be most carefully watched, for remedies of this class will undoubtedly become necessary at a subsequent period.

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* In florid patients, the face may from the first be flushed instead of pale, but I feel sure that pallor is its most frequent condition. In some of the most severe cases of traumatic peritonitis which I have seen, the patient looked in the early stage as pale as if she had been profusely bled. I have not mentioned rigors as an early symptom. Many cases of peritonitis set in without any marked shivering fit; sometimes a slight feeling of faintness, which rapidly passes off, and then returns again, appears to take the place of a true rigor. Later in the case, after the peritonitis is well established, occasional shivering is rarely absent, but, at the same time, it is not often severe.

With regard to the management of the wound, the following hints may be given. The portion of pedicle or of cyst left above the clamp should be cut close away on the day following the operation, as there will then be no risk of slipping, and it is very desirable to avoid fœtor. The clamp itself may be removed on the second or third day. The hare-lip pins should be left to the fourth or fifth; and when they are removed, the greatest possible care should be taken to support the abdomen and wound by long and broad strips of plaster, and the firm application of the flannel bandage.

In a successful case of ovariotomy the patient will often be able on the second day, or it may be even on the first, to take food by the stomach without risk. In not a few the progress of recovery is as rapid as it usually is after a favourable childbirth; and the patient may be able to leave her bed on the tenth day, or from that to a fortnight or three weeks. If, however, suppurative peritonitis have occurred, the convalescence will be much delayed. There will probably be profuse discharge from the wound; and to secure the escape of this, it will be needful to turn the patient on her side at the time of each dressing. In such cases, the patient is fortunate if she be able to leave her bed at the end of a month or six weeks. In most cases in which the peduncle is left in the abdomen, more or less of suppuration from within must be expected. In those in which the opposite practice is adopted the wound usually heals by first intention.

Having thus sketched briefly the course of an ordinary operation, and the after-management of the patient, there yet remain certain occasional difficulties and certain moot questions of treatment which demand more detailed consideration. To take them seriatim.

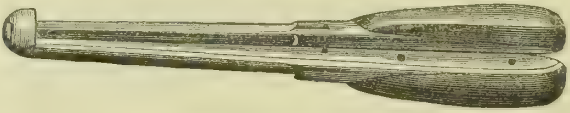
Is the long or the short incision preferable?—There has been much confusion in the description of cases as to which should be assigned to one or the other category. The distinction is purely arbitrary. Should the incision be measured before the removal of the tumour or afterwards? for one which would be considered long whilst the abdominal walls were distended might count as short when they had collapsed. Experienced ovariotomists are, I think, all agreed that a few inches more or less in the length of the wound do not constitute an important element in the chance of recovery. All will also admit that it is far better to enlarge the incision than to lose much time in futile endeavours to extract a multilocular tumour through a small one. On the other hand, no one will contend that a patient has any better chance on account of a large incision. We come, then, to the conclusion that the first incision should be of medium extent, and that the surgeon should be prepared to enlarge it if needful. About four inches, or just large enough to admit the knuckles, is perhaps a fair average measure; but in a few cases, in which there may be good reason to believe that the cyst is single, a much smaller one may be tried.

Adhesions.—I have already insisted on the importance of detaching adhesions as much as possible before the fluid is evacuated. For this purpose, if the adhesions are extensive, it is usually necessary to introduce the whole hand, and, carrying it between the peritonæum and cyst, by a lateral movement, break through all connecting bands. Not unfrequently, however, the more important adhesions are found behind the cyst, uniting it to the viscera, or to the lumbar or pelvic peritonæum. These cannot, as a rule, be reached until the cyst has been partially emptied. In separating these, great care must be taken not to drag too forcibly on the peritonæum. Not only may injury be done by tearing up the serous membrane from its attachments, but lacerations of viscera or of large vessels may occur. The movement employed should still be as much by a lateral sweep, and as little by direct pulling, as possible. The peritonæum should be supported by the other hand, or by other fingers of the same. It is better, under all circumstances, to tear rather than cut; but when important viscera are involved, such as the intestines or gall-bladder, it may become needful to resort to a careful dissection.

That the existence of adhesions to a moderate extent does not materially prejudice the patient's prospect is generally admitted. There seems to be less danger of acute diffuse peritonitis in such cases than in those in which the integrity of the serous sac has never before been interfered with. On the other hand, adhesions prolong the operation and cause risk of hæmorrhage, and in these respects are prejudicial. If very extensive or very strong, they may constitute a serious complication.

Adhesions to the omentum are very frequent, but are for the most part easily dealt with. If very vascular, the omentum may be tied, and the end brought out into the wound. Dr. John Clay has devised an 'adhesion-clam' for holding bands of adhesion whilst they are cauterised or rubbed through, &c.

Fig. 319.



Clay's adhesion clam.

A special difficulty caused by adhesions in front.—In cases in which the adhesions to the parietal peritonæum at the place of incision are intimate, great difficulty may occur in distinguishing the cyst. The operator may mistake the cellular interspace between the transversalis fascia and the parietal peritonæum for that between the cyst and the latter, and proceed to break down the connecting tissue. This error, although hitherto little if at all mentioned, has repeatedly occurred; and it is one which, if not very quickly discovered, may lead to great damage. On the other hand, the surgeon may, in his anxiety to avoid this, commit another. He may incise the visceral peritonæum of the cyst, and proceed to separate it. This error is less serious than the other, but it may cause great difficulty and much loss of time. In many cases the exterior of the cyst, deprived of its peritonæum, is smooth, white, and glistening; the adhesions are cellular, and easily broken through; so that there is nothing whatever to apprise the operator of his mistake. I know of but one plan by which, in case of perplexity, to avoid at once all risk of these two errors; and it is this: to enlarge the wound upwards until the peritoneal cavity is opened at a part where no adhesions exist. When once the operator's finger has touched intestine, he knows where he is, and may proceed to detach adhesions without any chance of mistake.

Multilocular cysts.—The operator should always be provided with at least two trocars, so that he may, if needful, puncture any second cyst which may present itself. If the cysts be very numerous and many of them of considerable size it may greatly expedite the operation to cut freely into the largest with a scalpel, and then introduce the hand into the interior, and break down their dissepiments. Of course before this is done the cyst should have been partially withdrawn and secured, and the patient placed well over on her side. Or, instead of making a large incision into any one of them, the tumour may be dragged forwards, and each single one punctured individually as they appear in the wound.

Prevention of escape of cyst-fluid into the abdominal cavity.—This is of very great importance. No single precaution is, I am convinced, more effectual in securing it than that of turning the patient over on her side. By this means a depending opening is given by which the fluid may escape, and the chance of its gaining access to the peritonæum is very greatly lessened.* The patient should be turned over to that side on which the intestines are supposed to lie, *i.e.* with that side uppermost from which the tumour is believed to originate. During the removal of the tumour, an assistant should most carefully keep the edges of the wound pressed together, and, after its completion, a piece of flannel should be at once carried over the wound, beneath the cyst. If by any chance cyst-fluid have escaped into the peritonæum, it is doubtful practice to do much in attempting to remove it. A piece of soft scalded sponge is better for the purpose than flannel; but too much painstaking in this matter would probably cause more danger than it would prevent.

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* Mr. Spencer Wells has devised an ingenious and, I believe, very useful appendage to the ordinary canula, by which the slipping of the cyst is prevented. It consists of toothed springs, which clamp the cyst firmly to the sides of the canula.

Management of the peduncle.—The operator has his choice of numerous different methods of securing the peduncle, each of which has its advantages and its drawbacks. 1st. He may tie it with a hemp or a strong silk ligature, either in one piece or by transfixion in two or more parts; and then, having cut away the tumour, allow the stump to slip back into the abdomen, the ends of the ligatures being brought out at the wound. The advantages of this method are, that there is no traction on the peduncle, and by leaving the ligatures on, they secure an open channel for the escape of pus, and also allow of their safe removal when loose. Its disadvantages are, that the sloughy stump of the peduncle with its attached ligatures returned into the peritoneal sac are very likely to set up peritonitis. 2nd. The peduncle may be tied as in the first method; and then, the ligatures have been cut close off, the whole may be returned, and the abdominal wound closed. In this plan it is hoped that the external wound will heal, and the portions of ligature left in the peritonæum become encysted, and cause no irritation. Nothing but the large amount of success which has recently followed the adoption of this most unsurgical method appears to me to justify it. Its disadvantages as regards the probability of peritonitis, and the risk of hæmorrhage from slipping of the ligature (it being part of the plan to cut the peduncle close to the ligature) are evident. 3rd. The peduncle may be divided by the écraseur or by the actual cautery. The time necessarily employed in dividing the peduncle, and the risk that intra-abdominal hæmorrhage may subsequently occur, are the drawbacks to this plan. The first might probably count for little; but the latter, especially in the case of a thick vascular peduncle, is most grave. Its advantages are, that it entirely obviates the dangers incident to dragging on the peduncle, and at the same time leaves neither sloughy tissue nor ligatures in the peritoneal sac. In all the preceding methods the stump is returned into the abdomen under circumstances more or less unfavourable as regards the risk of its causing peritonitis. We now come to the plan which may probably be considered as one of the chief modern improvements made in the operation. I allude, of course, to the principle of endeavouring to keep the end of the peduncle altogether out of the abdomen. This principle may be carried out either by the use of ligatures (hemp, silk, or metal), or by resort to a metal clamp. The latter instrument has the advantages that it can be applied easily and speedily, and with greater security as regards hæmorrhage. Various modifications in form have been proposed by different operators; but the most simple, and, I believe, the best, is one which resembles a pair of carpenter's callipers, but from which the handles are removable. It should be pressed tight with great force, and the screw by which it is fixed should be screwed

FIG. 320.

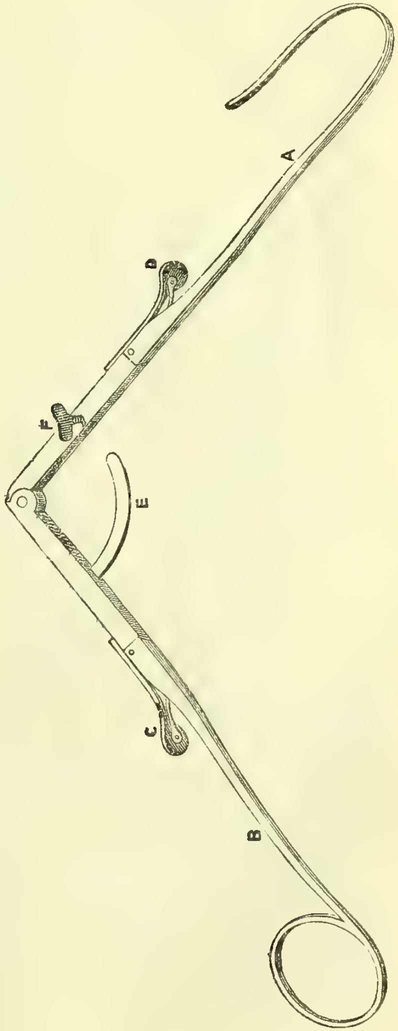


FIG. 320.—The calliper-clamp open, and with its handles attached. A and B the handles, C and D the spring catches by which the handles are fixed, E the curved rod which traverses the handle A when the instrument is closed and is secured by the screw F.

FIG. 321.

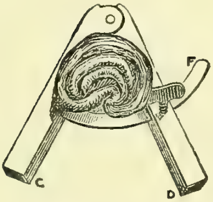
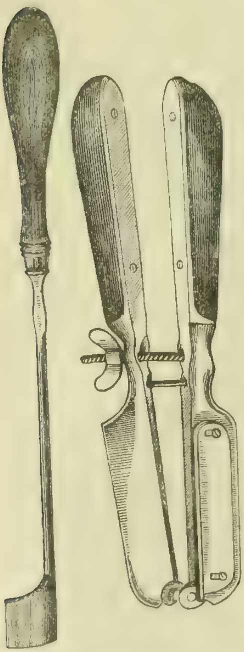


FIG. 321.—The clamp in position, the tumour having been cut away, and the handles of the instrument removed. For convenience in showing the outline of the instrument, the cyst has been represented cut away almost close above it. This in practice ought never to be done; but a considerable mass should be left above the clamp to prevent risk of slipping.

down with the assistance of forceps to prevent all possibility of slipping. It is a good precaution to push two or three needles through the peduncle above the blades of the clamp, and an absolutely essential one to cut off the tumour at a considerable distance above it. In cases in which the peduncle is long and slender, the action of the clamp is most satisfactory, and no inconvenience whatever results from its use. In those, on the contrary, in which the peduncle is short, and still more in those in which a peduncle can scarcely be said to exist—the base of the tumour itself occupying the entire expansion of the broad ligament,—the application of a clamp is difficult and inconvenient, and very hurtful traction on the uterus and pelvic peritonæum will be caused. The amount of traction may, in very thin patients, be not great at the time of the operation; but it will increase afterwards, should the abdomen become distended. How best to manage short peduncles is still one of the problems of the ovariotomist. In some cases it may be practicable, after the tumour has been cut away, and when, in all probability, the mass left on above the clamp has considerably shrunk, to reapply the clamp somewhat higher up. In order to effect this to best advantage, the operator should be provided with two clamps of similar size and make. One of these may be applied above the other, the screw having been, of course, removed from the lower one, and its handles being simply held together by an assistant. The lower clamp having been removed, the process may, if practicable, be repeated, and in this way an inch, or an inch and a half, might easily be gained in the length of the peduncle. It is true that part of the peduncle to be left in the wound will have been somewhat contused; but probably not so much as to endanger its vitality, or cause it to become a source of irritation. It may be borne in mind also that this portion will, should the abdominal parietes be thick, come

FIG. 322.



Clamp and cautery iron for cautery-section of the pedicle in ovariotomy. The blades of the clamp are partly of wood and in part of metal.

in contact rather with the edges of the wound than with the peritonæum.

On the whole, I think that the operator will do well to determine to use the clamp in all cases in which the peduncle is long enough; in cases in which it is too short it will be better when practicable to employ ligatures, and to let the peduncle sink into the wound so that the seat of ligature is level with the peritonæum; and lastly, in cases of extreme shortness he should use the actual cautery. In spite of recorded successes, I cannot but feel a strong prejudice against cutting ligatures and peduncles off short, and dropping the stump into the abdomen. This incurs the risk both of hæmorrhage and peritonitis.

Closing of the external wound.—This is an easy matter, and may be done with equal facility either by harelip-pins or silver wire. If pins are used, they must be gilt or silvered, not plain steel. The practice of Mr. Spencer Wells has proved that it is safe to pass the needles through the peritonæum; but it may be doubted if any material advantage is obtained. If not through the peritonæum, the ligature or pin should pass close to it through everything else. It is always well to transfix the peduncle, and thus secure it firmly in the wound.

Why has ovariotomy been appreciated more highly of late years than formerly?—The new method of keeping the end of the peduncle outside the abdomen is, I believe, the chief improvement of recent times. No doubt something has been done in the introduction of more cautious after-treatment, especially in the comparative disuse of opium. But chief amongst the reasons of the advance of ovariotomy in general favour is, *that it has been largely and openly tried.* Even in reference to the improvement in keeping the end of the peduncle out of the abdomen, if we put confidence in statistics, we must admit that those of Dr. Clay and Mr. Walne, who did not adopt it, are at least as good as those of other operators.* Even at the present time ovariotomy, as practised in isolated cases, and especially in the large hospitals, is attended by a very great fatality. It is only in the hands of those who have had considerable experience of its details that its ratio of mortality begins to improve. The reason why the mortality in our large hospitals appears to have been so high is in part explainable by what has just been hinted at, and in part by the fact that all such cases are made public, whilst a large majority of the unsuccessful cases occurring in private are not so. But after all allowance has been made on these heads, it still remains not improbable that the hospital air—germ-laden perhaps—which comes in contact with the peritonæum and wound during the operation, has something to do with the production of peritonitis.

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* Those of Dr. Tyler Smith, whose practice it has been to cut off the ligatures short and return the whole are perhaps the best yet obtained. They are, however, only limited in number.

What may the average success of ovariotomy be expected to be?—Those who allege that many fatal cases have been kept back, and that consequently statistics on this question are not trustworthy, have no doubt a certain amount of truth in support of their assertions. During the last fifteen years several operators have, however, publicly undertaken to disclose their whole experience; and there is, I think, no doubt that they have most creditably done so. From their statistics we gather that two recoveries to one death is a proportion which, in practised hands, may be confidently expected, and that perhaps we may even very considerably improve on this. Dr. Clay's table of cases from all sources give us 212 recoveries to 183 deaths; and, making allowance for unpublished cases, I fear we cannot hope that the gross mortality of the past has been less than one-half. In reference to all operations, and especially to these, the practical surgeon may most properly insist that deductions from general statistics are not to be applied too rigidly to individual cases. In many instances ovariotomy has been performed as a last resource, after the patient's powers had given way, and when the prospect of a favourable issue was very slight indeed. Now that the operation is fairly established in public confidence, we may expect that a considerable improvement in general results will follow, from the circumstances that a larger number of cases will be submitted to it at early periods of the disease. Although the results, even in many unhopeful cases, have been such that the ovariotomist scarcely feels justified in positively refusing to operate in any, yet there can be no doubt that it would be easy to select a certain number in which, if the credit of surgery is to be had in account, it would be wiser to decline it. Such are cases in which there is a history of severe attacks of peritonitis at some distant time; cases in which the tumour has existed for unusually long periods; and cases in which tapping has been very frequently performed, and the patient's strength has been greatly undermined. In the following remarks on the advantages accruing from the operation, as established by reference to arithmetic, I have, as will be seen, taken the lowest estimate of success, and in several other respects I have given the operation a less favourable position than it may, I believe, legitimately claim.

Remarks on the advantages of ovariotomy, as shown by statistics.—To compare its results with those of lithotomy, amputation, &c. is very much beside the mark, since operations performed with such differing objects, and under such different circumstances, afford no fair comparison. Each one must be considered on its own merits. The test I would propose is this: Let it be admitted that the object of surgery is the increase of the sum of human life, and the lessening of its disabilities and miseries. Whether this life is enjoyed by many individuals over short periods, or by few over long ones, is not of moment, if the sum of it be increased. If, then, we have 100 patients suffering from ovarian disease, and there is a fair probability that if all submit to ovariotomy, one-half will recover from the operation and be restored to perfect and, *quoad* the disease, permanent health, the calculation to be made will be simply a comparison of the sum of years which the 100 would have realised if not operated on, with that which the 50 recovered patients might be expected to attain. The ovariotomist can, I think, well afford to leave out of question the not unimportant factor, that the 100 would have been sufferers, many of them in an extreme degree, throughout the entire remainder of their lives; whilst the 50 would have been in the enjoyment, for the most part, of excellent health. Of 100 patients suffering from ovarian dropsy, in the stage in which such cases usually come under care with a view to the operation, it is exceedingly probable that for half of them twelve months would be the limit of life; 25 others might perhaps be expected to die within two years; and the remaining 25 would probably follow at various periods within ten years. If, therefore, we allow three years and a half as the average expectation of life to the whole, it will, I think, be admitted that it is a liberal calculation, and probably much higher than any surgeon would advise an Insurance Office to accept them at. The average age at which women submit to ovariotomy is 35, and the average expectation of life at this age is 30 years. The 50 patients who recovered might, therefore, expect to enjoy a total of 1500 years of health, which compares very favourably with the 350 years of illness which the whole 100 would have had to endure, if not operated on. If it be objected, that it is not just to one person to deprive her of four years of life in order that another may live 30, the reply is, that this is a matter for the patient to consider, and not the surgeon. It is part of the general lottery of life, and each patient takes her chance of a small loss or a large gain. All that the honest surgeon is responsible for is, that the prizes which he offers to the competition of his clients shall be *bonâ fide*, and in sum of value far exceeding the deposits which he exacts.

The only source of fallacy which I can see in this argument is the possibility that a few of the cures might not be permanent. Either the other ovary might be attacked, or cancer might be developed in some other organ. To this it may be replied, that experience has fully proved that in almost all cases the cures after ovariotomy are genuine and permanent. The exceptions to this have been exceedingly rare.

Errors in diagnosis.—The principal mistakes which have occurred have been in respect—1st, to solid, or partially solid, uterine tumours; 2nd, to phantom tumours; 3rd, to pregnancy; 4th, to ascites; 5th, to hydatid cysts; 6th colloid disease of the peritonæum; and, 7th, cysts in the broad ligament. One general remark may be ventured in reference to them all, and it is this, that the surgeon should place no trust in the patient's statements, but should, before undertaking any radical operation, carefully examine his patient by all practicable methods. A vaginal examination ought not to be omitted (unless the case is clear beyond a doubt), since in the very cases in which the surgeon may feel most inclined to omit it (those, namely, of single women), it is the most likely that a misleading history may have been given. Keeping in mind that ovarian tumours ought to be perfectly dull in front, and should leave a tympanitic space in one or in both lumbar regions, there will rarely be much difficulty as regards ascites or phantom tumours. Should any doubt be felt, changes of the patient's position, and re-examination by percussion, will generally clear it up in respect to the former; and the exhibition of chloroform in regard to the latter. I am not aware that any radical operation has ever been attempted in a case which proved to be one of simple pregnancy; but as in not a few such paracentesis has been resorted to, we must always bear in mind the possibility of that error. In two or three cases of ovarian dropsy, complicated by existing but unrecognised pregnancy, ovariotomy has been performed, and in one at least with success. Provided the uterus is not interfered with, this is, perhaps, not a very dangerous blunder. The power which pregnant women possess of resisting severe injuries is remarkable. The differential diagnosis between uterine and ovarian tumours is by very far the most difficult of those under consideration, and under some circumstances may be impossible. The history of uterine hæmorrhage, the slower growth, the greater solidity,* more or less of fixation to the uterus, are symptoms by which those of uterine origin may usually be known. If there is doubt, it will be well to wait; for, provided the uterine tumour be innocent, it will not attain any enormous size, and may not improbably begin to diminish after a time.

Whilst an ovarian tumour is small, and especially in a fat abdomen, the establishment of a positive diagnosis may often be attended with insuperable difficulties. In cases, however, in which an operation is legitimately in question, the difficulties will usually have disappeared with the increase in size of the cyst. In cases of 'phantom tumour' especially, the surgeon may, not unfrequently, feel unable to assert the negative as to ovarian dropsy; but if he is satisfied that there is a clear percussion-note over any considerable extent of the front of the abdomen, he will of course decline to entertain the question of an operation. The usefulness of chloroform inhalation in affording facilities for clearing up these cases cannot be overrated.

XI. Fistulæ communicating with the Vagina or Uterus.

Fistulous openings may exist—1st, between the urethra and vagina; 2nd, between the bladder and vagina; 3rd, between the bladder and uterus; 4th, between the vagina and rectum. In certain cases a common communication may open bladder, vagina, and rectum into one. We shall omit here all consideration of openings caused by the extension of cancerous ulceration, since they are quite beyond surgical treatment. The various forms of simple fistulæ usually result either from contusions or lacerations in parturition, from the introduction of foreign bodies, or from the effects of calculous concretions in the bladder, or operations for their removal.

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* Uterine fibroids not unfrequently soften in the centre, and present the symptom of fluctuation, more or less clearly marked. They often attain a size sufficient to distend the abdomen, as at the period of advanced pregnancy. On three different occasions patients have been sent to me with a view to the performance of ovariotomy, when, on careful examination, I satisfied both myself and others that the tumour in question was in reality uterine. In all these, hæmorrhages, had, at an earlier period, been a prominent symptom.

The inconvenience caused by any communication between the *bladder* and adjacent cavities is extreme, since it is usually attended by constant incontinence of urine. A large opening may, however, exist between the *rectum* and vagina without exposing the patient to much annoyance, since in many cases the involuntary escape of fæces occurs only when the motions are unusually fluid. So great and so general has been the success obtained by operators in the cure of most of these forms of fistula, that it is scarcely worth while to occupy space by reference to less efficient modes of relief. It is admitted on all hands that, although by the use of the actual cautery small fistulæ may be much diminished, yet that they can very rarely indeed be made wholly to close, and the after-treatment in these cases is just as irksome as in those of operation. On the other hand, the results obtained by Dr. Bozeman, Mr. Brown, Mr. Bryant, Dr. Marion Sims, the late Sir James Simpson, and Mr. Spencer Wells, have been so exceedingly satisfactory that we may fairly rank the operative cure of these distressing conditions as a finished achievement.

Considering the want of success which attended the attempts of the earlier surgeons, some of whom (especially Dieffenbach) devoted attention very perseveringly to the subject, it suggests itself as a most interesting question in practice, to what precise improvements have recent results been due? Speaking chiefly of vesical fistulæ, I think we may mention the following as amongst the chief: 1st, the use of chloroform, which enables the operator to proceed with much increased facility in the difficult steps of the dissection; 2nd, the use of metal sutures insteadof silk; 3rd, the avoidance of the vesical mucous membrane, both in the dissection and in the application of the sutures; and, lastly, increased attention to keeping the bladder empty afterwards. A few years ago much reliance was placed on metallic or wire shields, adjusted over the line of union; but these are now generally discarded, and reliance placed on sutures alone.

The following are the steps of the operation in a case of vesico-vaginal fistula: The patient should be in her best state of health, and the bowels should have been well cleared out. Chloroform having been given, the woman is placed either on her side, with the knees well drawn up, or in the usual lithotomy position. The parts being well exposed by the duck-bill speculum, and the nates being held widely apart by an assistant, the operator proceeds to drag the opening as low down as possible, with a view to facilitate the paring of the edges. This may be accomplished either by hooks, blunt or sharp; by the use of a metal suture; or by the introduction of a flexible sound by the urethra, which is brought out again through the fistula, and then bent backwards. This latter plan furnishes the surgeon with a most efficient hook, and one which cannot easily slip. In paring the edges, it is necessary thoroughly to denude every part; for if the smallest portion of mucous membrane be left, it may prevent union. None of the mucous membrane of the bladder must be removed. The wound should present a bevelled oblique line, slanting from a large vaginal opening to a smaller vesical one. The denudation being complete and free, sutures are next to be introduced. These should be passed obliquely from at least a third of an inch outside the edge of the incision. They must not include the mucous membrane of the bladder. The tightening and tying of wire sutures is easily accomplished by the fingers. Care must be taken not to pull them too tight, so as to invert the edge of the vaginal mucous membrane. The instruments used in these procedures consist of small knives, forceps, and needles of various construction. Startin's tubular needle for carrying wire is in most cases the best. Provided the precautions insisted on, as to avoidance of the mucous membrane of the bladder, be observed, it does not appear that there is such great difference in result from wire or silk ligatures as was at one time supposed. Still it is certain that wire is not more irritating than silk; and as it is at least equally easy to use, it may be considered preferable.

The after-treatment consists chiefly in great attention to keeping the bladder empty. A catheter, either the small silver one introduced by Dr. M. Sims, or a common flexible one, should be retained; and it should be a nurse's duty to see that the urine is constantly flowing. The catheter should be changed and cleaned twice daily; and if at any time the flow of urine stop, it should at once be examined. The patient must lie on her side, with the knees drawn up, and every attention must be paid to sustaining her general health.

The sutures may be left in almost indefinitely; and unless it is clear that the operation has failed, they should certainly not be removed till the ninth or tenth day. If cicatrisation has occurred, they will cause no inconvenience; and their retention a few days longer than is absolutely necessary is a matter of no consequence, whilst their premature removal is a very grave error. It is needless to say that their removal should be effected with every precaution.

The nearer the fistula is to the urethra, the more easy is the operation in performance, but the greater is the chance that it may fail. One difficulty in closing urethral fistula arises from the fact that the catheter almost necessarily presses upon the line of union.

In cases in which the fistula is very high up—or it may be even connects the bladder with the cervix uteri—certain modifications in the plan of operation will be required. It may even become desirable to obliterate the upper part of the vagina, and to connect the uterus with the bladder, thus allowing the menstrual fluid to pass per vesicam, but preventing incontinence of urine.

The operation in cases of recto-vaginal fistula does not differ materially from that just described. The paring of the edges must be practised in a similar manner, and care must be taken to avoid the rectal mucous membrane. The bowels must be kept from acting for ten days subsequently, and it may be well also to retain a catheter in the bladder. Whether or not the sphincter ani should be divided will depend upon the degree of tension which is present when the parts are brought together. It is not a slight measure, and should not be needlessly resorted to. In these, as in the preceding cases, the unencumbered suture of twisted wire is better than any form of compress or button, and far better than the shotted one. After the operation the vagina should be washed out by injections of tepid water daily.

XII. CÆSARIAN SECTION.

It would be out of place here to consider any of the questions respecting the cases demanding this formidable operation, but it is desirable to describe its performance. The surgeon must provide himself with scalpels, directors, and forceps, and should have also a large probang armed with sponge. The patient should be placed on her back, with the shoulders and trunk a little elevated. The bladder should be emptied by means of the catheter. Before beginning, a final examination should be made to ascertain whether the bones may not be yielding, for in osteo-malacia the hope of natural delivery should never be abandoned absolutely. The incision through the abdominal wall must be made as in ovariotomy, and should extend from the navel to within two or three inches of the pubes. The uterus having been exposed, it should be held forwards by side pressure on the abdomen, and opened freely by an incision in the middle line. The incision should not involve either the fundus or the cervix. An assistant may now introduce a forefinger of each hand into the upper and lower angles respectively of the wound, and thus hook the organ forwards. After rupturing the membranes, the child is to be seized by the feet and extracted. The hand is next to be introduced between the membranes and the anterior wall, and the placenta is to be detached and removed. If the placenta have been found beneath the wound, it may have been necessary to detach it before removing the child. At this stage, the troublesome part of the operation, the risk of hæmorrhage will be encountered. To restrain bleeding, the uterus should be compressed in the hand, or ice may be used, or under urgent circumstances, the perchloride of iron. Before closing the wound, the surgeon should pass the sponge-probang downwards, through the cervix into the vagina, to clear the passage. All bleeding having ceased, care should be taken to remove any coagula from the uterine cavity, the wound, and the peritoneum. The decision as to the use of sutures to the uterus or not, will depend upon the tendency to gape which may be observed. If there is much gaping, it will be better to put in a few interrupted sutures—Lister's carbolised gut might have advantages—and cut them off short. The wound in the abdominal wall must, lastly, be closed completely, as after ovariotomy.

The after-treatment will consist in the efficient use of ice-bladders to the abdomen, and the internal administration of opium if required. Great care should be exercised in allowing the patient to take food if there is any tendency to sickness. Under such circumstances it will be far better to sustain her strength by enemata.

I cannot forbear the expression of a hope that this operation may not become fashionable with obstetricians. Nothing is more absurd than to compare it with ovariotomy, and to hope that the dangers of the one will be reduced as have been those of the other. It is a most formidable procedure, warrantable only under the most exceptional circumstances.

JONATHAN HUTCHINSON.

DISEASES OF THE MALE ORGANS OF GENERATION.

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FAILURES IN DEVELOPMENT OF THE TESTICLE.

THERE are two peculiarities in the development of the testicle which deserve notice here, forasmuch as they are related to certain peculiarities in the pathology of the organ. *First.* Each testicle is formed from two distinct parts. The *body* of the gland is produced from primitive fœtal structure in front of, but apparently independent of, the Wolffian body, or temporary kidney, which lies along the hinder wall of the abdomen; whereas the *epididymis* is evolved from the lower part of the Wolffian body itself, and from the duct of that body, the vas deferens being the continuation of the Wolffian duct of the lower and hinder part of the bladder.* Reminiscences of this mode of development are furnished by the vessels which supply the two parts. The spermatic artery, derived from the aorta a little below the renal arteries, is distributed chiefly to the body of the testicle; and the deferential artery, from the hypogastric, is distributed to the vas deferens and part of the epididymis, the remainder of the epididymis being supplied by the anastomosing branch between the spermatic and the deferential arteries. The close sympathy also of the epididymis with the several parts of the urinary apparatus, particularly with the prostatic part, evinced in the frequent excitation of inflammation in it by irritation in the urethra, bladder, or kidney, and the manner in which that inflammation is commonly confined to it, without spreading to the body of the testicle, are probably, in some measure, due to the mode of development of the organ.

The *second* peculiarity is the change of position from the lumbar region to the scrotum, which takes place gradually during the fœtal state, and is usually accomplished before birth. The physiological purpose of this change of position, and the means by which it is effected, are not quite clear. Viewing it in a pathological light, we feel that had the testicle been retained in the abdomen, and possessed the same sympathies and liabilities to disease which it now has, it would have proved a troublesome companion to the other viscera. At the same time it would have been less exposed to injury, and the many maladies consequent on its passage through the abdominal wall would have been spared. We must not forget that the covering of peritonæum, which it acquires in its course is a considerable protection against injury and against the extension to it of disease from the skin and superficial structures of the scrotum.

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* Kölliker, *Entwickelungsgeschichte des Menschen und der höheren Thiere,* p. 443.

The question of *supernumerary testicles* may be dismissed with the statement that there is no clear evidence of one having ever been met with. The claimant to this distinction has in each case, when it has been submitted to dissection or to careful examination, proved to be either a cyst or a fatty or fibrous tumour in the cord or in some part of the scrotum, or a piece of omentum.*

Imperfect development.—In some few instances there has been complete *absence* of one or of both testicles, accompanied occasionally, but not always, by more or less deficiency of the other parts of the generative apparatus. It is remarkable that the vas deferens and vesicula seminalis should be present and grow when the testicle is absent; and it is still more remarkable that in some cases of deficient testicle, the vas deferens of natural size, or nearly so, has been traced into and through the inguinal canal.†

The cases in which the vas deferens has been found deficient in some part of its course are more numerous. The deficiency occurs most frequently near the testicle, occasionally near the bladder, and more rarely in its whole length. In some of these cases the epididymis has been also absent; but in others it was present, and was, like the testicle, as large as usual. These varieties do not admit of precise explanation in the present state of our knowledge of the mode of development of the organs; but they show that the development and growth of the several parts of the genital apparatus may go on independently of one another, however essential each may be to the function of the others. Both testicle and vesicula seminalis may be well formed, and may continue to be well nourished, though entirely useless, from the want of a vas deferens to connect the one with the other; so that the plumpness of a testicle and its descent into the scrotum are no certain indications of the performance of its function being possible.*

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* Cases of supernumerary testicle are recorded in the *Lancet*, 1865, pp. 448, 473, 501. There was, however, no proof beyond that of external examination in any of the cases.

† Case and résumé of cases by Mr. Paget, *Med. Gazette*, vol. xxix. p. 817; also Curling, *Diseases of the Testis*, 1856, p. 3. Ernest Godard has investigated the subject of deficiency of the testicle and seminal apparatus with greater assiduity than any other person. *Recherches sur les monorchides et les cryptorchides chez l'homme*, Paris, 1856; *Études sur la monorchidie et la cryptorchidie chez l'homme*, Paris, 1857; *Études sur l'absence congéniale du testicule*, Paris,

The independent growth and secretion of the vesiculæ seminales explains the fact, that the person in whom the testes are absent or wasted may possess virile power, though of course he will be sterile.

A man, aged forty-four, whose scrotum is small and the testes can scarcely be said to exist, the vas deferens on either side terminating in a small firmish lump, which appears to be a diminutive epididymis and which is very tender, tells me that he has by no means a want of sexual propensity or power; on the contrary, he was very dissipated before marriage, and indulged every night for the first three years afterwards; but never had children. To the best of his belief, the testes have been in their present condition from birth; at least he never knew them to be otherwise. When he was eight years old, disease, probably gonorrhœa, was communicated to him by a maid-servant, who was transported for seven years for the offence. Whether this had any effect upon the organs he cannot tell. He has beard and moustache, and presents no indications of want of virility. A man with testicles in a similar condition from birth, was lately a patient at Addenbrooke's Hospital. He stated that his wife had children.†

1859; *Mémoires de la Société de Biologie*, 1856, p. 216; 1857, p. 382; 1859, vol. i. p. 311 and p. 327. See also Royers, *Des oblitérations des voies spermatiques*, in Canstatt's *Jahresbericht*, 1858, vol. iii. p. 383.

* The experiments on animals by Sir A. Cooper, *On the Testis*, p. 51; Mr. Curling, *Diseases of the Testis*, p. 11; and M. Gosselin, *Archives générales de Médecine*, Sept. 1853, indicate that the division of the vas deferens has little or no influence upon the nutrition of the testicle; and atrophy or removal of a testicle is not usually followed by wasting of the corresponding vesicula seminalis.

† See case of apparently undeveloped testes retained in the groin; the man's wife had family: *Path. Trans.* vol. xix. p. 288. M. Liégeois (*Med.*

A gentleman, from whom both testicles had been removed, informed me that the operation had caused no difference in his sexual inclination and power. I should add, however, that another patient similarly circumstanced told me that he was impotent soon after the loss of the organs.

Retention of testicle.—The descent of the testicle is delayed till a few months, or a year, after birth in about one infant in five. It may take place later. Sir A. Cooper has ‘many times seen the testes descending from thirteen to seventeen years, probably from new excitement at that period; and the descent is in some cases not accomplished till twenty-one.’ Under these circumstances the testicle is liable to be accompanied or followed by a portion of intestine, forming a ‘congenital hernia,’ and not unfrequently the bowel is adherent to the gland.* In about one person in a thousand one of the testicles (the right or the left in a nearly equal proportion of cases) is permanently retained in the abdominal cavity or in the inguinal canal or the groin. In a few instances this happens with both testicles. The cause of the failure is probably, in most cases, a deficiency in the force, whether it be the contraction of the fibres of the gubernaculum or some other, by which the descent of the gland is effected. Sometimes there has been an impediment to the process, either narrowness of one of the inguinal rings, or an obstacle in the inguinal canal, or adhesions to some of the viscera or to the abdominal wall, consequent on intra-uterine peritonitis, or an imperfect development of the

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Times and Gaz. 1869, vol. ii. p. 247) has made many observations, and believes that all healthy persons, even octogenarians, carry in their semen the material elements of fecundation. Chronic diseases, as phthisis, are attended with a diminution of spermatozoa. Cryptorchids, however, are sterile, although their stature, physical powers, and moral faculties may be developed, as in other men. The same author (*Med. Times and Gaz.* Nov. 6, 1869) gives two observations of imperfect development of the testes from Curling and Laborde, in both of which spermatozoa were absent, and states that he has examined the seminal fluid of six persons who presented an atrophy of one of the testicles, and found a diminution of spermatozoa, as well as of the virile faculties in each.

* That hernia is not always an attendant on late descent of the testicle is proved by Malgaigne's case of a boy aged thirteen, whose left testicle suddenly descended into the groin in consequence of a fall, and was not followed by rupture (*Anat. chirurg.* vol. ii. p. 266). I was lately consulted, for inflammation of the bladder, by a patient aged sixty, both of whose testicles were retained and did not pass the external ring till he was forty. The protrusion was regarded as rupture, and its further progress prevented by a double truss. He married a woman older than himself when he was thirty, but never effected an entrance, because the emissions took place too soon.

'mesorchium.' Shortness of the vas deferens or other vessels may also be mentioned among the causes of failure of descent of the testicle; though in several instances they have been shown by dissection to be tortuously disposed.*

The *condition of the imperfectly descended testicle* has been a matter of anxious inquiry. It has, in a few instances, been found of full size;† but as a general rule, it is imperfectly formed, or smaller than natural, its glandular tissue retaining the immature characters of the infantile organ; or it may be atrophied, in a state of fibrous or fatty degeneration, and presenting scarcely any trace of glandular structure.‡ This may be in consequence of the position being less favourable than the scrotum is to its nutrition.§ Whether that be the cause or not, the relation between imperfection of development and incomplete passage to the scrotum is frequently to be observed. Although, therefore, it is quite possible, in any case, that the retained testicle may perform its functions, yet there must always be great suspicion of its inefficiency. Where the other testicle has descended and is natural, this is of little consequence, one testicle being quite sufficient for generative purposes; but where both testicles are retained, the virility must be a matter of anxiety and much uncertainty. Proofs, however, are not wanting that impotence is no necessary result of this condition.‖

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* In each of three specimens of undescended testes in Guy's Museum, a peritoneal pouch occupies and projects a little beyond the inguinal canal, and there appears nothing in the canal to prevent the descent. The cause of its failure is not apparent in any of the cases. The testicle in each is rather small.

† Cloquet, *Sur les Hernies abd.* Cooper, *On the Testis*; in this patient, who committed suicide, the gland was *nearly* of the natural size.

‡ *Brit. Med. Journal,* 1859, p. 110; report of discussion at Med.-Chir. Soc. Curling, p. 27; and *Brit. and For. Med.-Chir. Rev.* April 1864.

§ This view is supported by the instances in which the testicle has been retained in the abdomen by adhesions, and yet has been stunted in its development or growth; *Trans. of Path. Soc.* vol. viii. p. 265; also by the case of a Parisian mentioned in *Med. Times and Gaz.* vol. xviii. p. 67, whose right testicle was suddenly and violently drawn up into the inguinal canal during masturbation when he was young, and never reappeared. The body of the testicle was found much atrophied, soft and pulpy, and but one-fifth of the size of its fellow.

‖ Hunter's *Works,* by Palmer, vol. iv. p. 18; Curling, p. 26; *Brit. Med. Journ.* 1859, p. 110; Poland, *Guy's Hosp. Reports,* 2nd series, vol. i. p. 162. Mr. Coulson stated at the Med.-Chir. Soc. Jan. 11, 1859, that he was 'consulted in a case in which neither testicle had descended into the scrotum, one being in the inguinal canal, and the other in the abdomen. This gentleman married and was able to perform his marital duties.'

Some opinion may be formed by the presence or absence of those external indications and those propensities which are usual attendants upon virility. These, however, are not quite to be relied on as evidence of the power of impregnating the female; for in some cases of the kind there has been virility and seminal emissions during connection and at other times, although there were no spermatozoa in the fluid and no power of impregnation.*

Diseases of retained testicle.—The recorded instances of disease in the testicle when retained in the abdomen are few. In a case related by Dr. G. Johnson,† it was the seat of malignant disease. When in the inguinal canal it is as liable to inflammation from gonorrhœa as when it is in the scrotum; and the pain is more severe, in consequence of the confined position of the gland, and the pressure of the abdominal muscles upon it. In this situation it has been the seat of malignant disease; ‡ and it also sometimes suffers from the pressure of the muscles, especially about the time of puberty, or from being displaced by a sudden strain, and forced into a narrow part of the canal. In some instances of this last kind such repeated attacks of inflammation ensued as to necessitate the removal of the gland.§ The symptoms, under these circumstances, have been so violent as to be mistaken for hernia,* and have even led to an operation upon the tumour.† A correct diagnosis in such a case must be difficult, sometimes impossible. The surgeon must be guided by the general symptoms. If, after the employment of the ordinary remedies, they continue to indicate strangulation of intestine, he should not hesitate to cut down upon the swelling, and ascertain the real nature of its contents. A testicle retained behind the abdominal ring in the inguinal canal, and inflamed, may be mistaken for bubo, the accompanying blush in the skin suggesting that suppuration has taken place. Ricord was nearly deceived by a case of the sort.‡ Sir A. Cooper observes, 'it often happens that when a testis remains in the inguinal canal, there are severe spasms of the cremaster or muscles of that canal, accompanied with violent pain, and only relieved by the hot bath and by fomentation.'

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* *Med. Times and Gaz.* vol. xx. p. 101; *Trans of Path. Soc.* vol. xi. 160. Godard, *Études sur l'absence congéniale du testicule*, entertains the view that a testicle which is arrested in its passage to the scrotum never secretes spermatozoa or fluid capable of impregnating the female. In a paper on sterility in man, with cases, read before the Med.-Chir. Soc. June 23, 1863, Mr. Curling observes that 'spermatozoa have not been discovered after death in the spermatic rings of a detained testicle in any one instance that he knows of.' See *Path. Trans.* vol. xii. p. 143. Cryptorchids may be, and sometimes are, *virile*; but the facts which he has collected indicate that they are *sterile*; and he is inclined to call in question the claims to paternity which have been advanced in some of these cases. He speaks also of the effects of gonorrhœal epididymitis, tubercular deposits in the epididymis, and stricture of the urethra in causing sterility. See also *Brit. and For. Med.-Chir. Review,* April 1864.

† *Med.-Chir. Trans.* vol. xlii. p. 15.

‡ Mr. Arnott gives a case of this in *Med.-Chir. Trans.* vol. xxx. p. 9, and quotes others. Virchow, *Die krankhaften Geschwülste,* remarks that the frequency of malignant disease in the testicle retained in this situation is due partly to the injuries to which it is subjected by the contractions of the abdominal muscles, and partly to predisposition associated with its imperfect development. See also *Med. Times and Gaz.* Feb. 15, 1868, p. 176; *St. George's Hospital Reports*, vol. ii.

§ *Dublin Journal of Medical Science*, vol. xxvi. p. 257; *Medical Times and Gazette,* vol. xix. p. 379.

In a few cases the testicle retained in the inguinal canal has been the subject of hydrocele, constituting what has been called by Mr. Curling an inguinal hydrocele. The diagnosis in such a case would be based upon the transparency of the swelling, and the absence of the testicle from its normal position; and the treatment, whether palliative or radical, must be determined by the circumstances. Unless it were a source of much inconvenience, non-interference would be the most judicious course.§

Complication with hernia.—Retained testicle is sometimes complicated with hernia, which may pass beyond the testicle through the inguinal canal, and being unable to descend into the imperfectly-developed scrotum, may rise towards the ilium. The hernia is contained in the same peritoneal pouch as the testicle; and the complication may be embarrassing, from the testicle being unable to bear the pressure of the truss requisite to prevent the descent of the hernia. In the case of a lad, aged nineteen, the suffering from the compression of the gland was so severe that Mr. Solly removed the organ.‖

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* Richter, in Lawrence *On Hernia,* 5th edit. p. 571; Pott's *Treatise on Ruptures,* p. 352.

† Deliasianne, *Revue médicale,* 1840.

‡ *Prov. Med. Journal,* vol. vi. p. 264.

§ In *Trans. of Path. Society,* vol. ix. p. 316, is the dissection of a large hydrocele in the right groin, the testicle being undeveloped and detained in the inguinal canal. Dr. Gherini (*Annali Universali di Med.* vol. clix. p. 118, and *Brit. and For. Med. Rev.* vol. xxi. p. 268) relates two cases. Fatal peritonitis followed the opening of one; the other was cured.

‖ Curling, *On Diseases of the Testis,* p. 41. The removal of a retained

If a portion of bowel accompanies the testicle, it should be replaced, the testicle being left in the scrotum, and a truss applied between the two. Should the bowel, however, be adherent to the testicle, so that either the latter must be kept in the abdomen or the patient remain the subject of hernia, the former alternative is to be preferred, and the descent of both testicle and hernia must be prevented by a truss. It has now and then happened that a portion of bowel has descended into the scrotum, instead of the testicle. In such a case, if it be an infant, I think it better to leave the case alone for a time, in the hope that the testicle may descend, and that it may be possible to return and retain the hernia by a truss, while the testicle remains in the scrotum. Should, however, the testicle not descend, the hernia must be treated by a truss, and both it and the testicle be kept in the abdomen.

We know no means of determining or accelerating the descent of the testicle. Attempts have been made by operation to withdraw the gland from the inguinal canal and place it in the scrotum; but they have not succeeded sufficiently to encourage the surgeon to incur the risk of opening the cavities of the tunica vaginalis and the peritonæum, as well as the other dangers incidental to the operation.

Passage of the testicle into the perinæum.—In a few instances the testicle has passed beyond its proper bounds, and has become

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testicle is an operation not unattended with danger, forasmuch as the sac of the tunica vaginalis usually, though not always, communicates freely with the cavity of the peritonæum. In a case of neuralgic testicle, retained in the lower part of the inguinal canal, and removed by Prof. van Buren (*Amer. Med. Times*, March 16, 1861), the tunica vaginalis was closed at the internal ring, and did not extend into the scrotum.

I would remark, as a matter of some practical importance, that when hernia occurs with retained testicle, and indeed in other cases of congenital hernia, the stricture, if strangulation takes place, is usually in the neck of the sac; and it may be at some distance behind the internal ring, a pouch being formed between the peritonæum and the fascia transversalis, in which some of the hernia is contained. I have met with two examples of this. In each the external abdominal ring was tight and constricted the hernia; and we might have supposed this was the real stricture, had not the finger discovered that the bowel above was not free, but tightly strangulated more than an inch above the internal ring.

In a young man, whose testicle had descended only just below the external ring, hernia suddenly took place and was strangulated. The bowel, instead of passing downwards into the scrotum, ascended upon the oblique muscle nearly to the spine of the ilium. By drawing it forcibly downwards, and then manipulating above the ring, I succeeded in replacing it.

lodged in a pouch in the perinæum. In this situation it is a source of much inconvenience, being liable to be bruised in sitting or riding, so that it is necessary to use mechanical means for retaining it in the scrotum.

A patient with gonorrhœa complained of a painful swelling in the perinæum; M. Ricord, supposing it to be a perineal abscess, was about to open it, but discovered it was the testicle. He met with another instance of the same kind.*

Whether, in these cases, the testicle traverses the scrotum on its way to the perinæum, or passes from the external inguinal ring directly backwards, between the thigh and the scrotum, instead of downwards and inwards to the scrotum, is not easy to determine.

I was lately consulted by a gentleman, in whom the right testicle, of smaller size than the left, lay in the track just mentioned; that is to say, it was in the cleft between the scrotum and the thigh, having never entered the former, and the cord ran up from it straight to the external ring. He was not accustomed to ride on horseback, and did not suffer much inconvenience from the malposition.

Passage of the testicle through the crural ring.—Three cases of this are given by Mr. Curling: the testicle either making its exit through the saphenous opening and mounting upon the abdomen like a crural hernia, or lodging behind the fascia in the upper and inner part of the thigh.

Persistence of the canal between the tunica vaginalis and peritonæum.—This canal usually closes in its whole length soon after the testicle has reached the scrotum. Often, however, the process is delayed for a variable time after birth, in consequence, perhaps, of a hernia descending with the testicle; or the canal may be maintained by fluid secreted in the tunica vaginalis or in the peritonæum (it is not easy to tell which), and passing to and fro. In either case a remedy is to be found in a truss or pad applied upon the groin. Sometimes the closure is only partial, and spaces remain which may become distended with fluid, forming hydrocele of the cord; or a narrow channel may remain in the whole length, from the testicle to the abdomen, for years or for life. All surgeons of much experience will be able to confirm the following observation by Sir A. Cooper: 'The opening of the tunica vaginalis, in some instances, remains small until the adult age, and it then becomes suddenly dilated by a protrusion of intestine, producing hernia congenita; and when the surgeon in the operation discovers its nature, the patient assures him that he never had a hernia until a few days before.*

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* *Prov. Med. Journ.* vol. vi. p. 264. In the *Brit. Med. Journ.* 1858, p. 549, is the account of a case in which the testicle was thought to have been dislocated into the perinæum by a blow upon the pommel of a saddle. The gland remained in its abnormal position, an inch in front of the anus. An operation was attempted by Mr. Partridge, for the purpose of replacing the testicle in its position. This being unsuccessful, the organ was removed. It is not improbable that this testicle had descended into the perinæum in infancy, but was not a source of annoyance till the injury upon the saddle. Dr. Zeis (*Archiv für clinische Chirurgie,* vol. ii. p. 81) was about to operate on a lad, aged fifteen, for stone in the bladder, when he found the left testicle in the perinæum in the way of his intended incision, and he accordingly made the incision on the other side; the left side of the scrotum was very small. He quotes other cases of abnormal descent of the testicle into the perinæum and crural region.

Imperfect subsequent development.—Even though the descent of the testicles may take place properly, their subsequent development and growth may fail.†

In a single man, aged thirty, who died in Addenbrooke's Hospital of phthisis, I found the testicles no larger than horse-beans. They presented no trace of disease, were soft and even on the surface, with the usual lobular divisions in their interior; but instead of the ordinary glandular structure, there was a reddish granular substance in which I could discover no tubules. The epididymes were also small; the vasa deferentia were of their natural size; the vesiculæ seminales about half as large as usual; the prostate and bladder healthy; the penis of natural size; hair on the pubes, a beard and proper muscular development.

Inversion.—Now and then there is inversion of the part; the vas deferens and the epididymis presenting in front, and the body of the testicle being behind; and this may lead to difficulty of diagnosis when there is disease. The other day, examining a case of epididymitis, I was puzzled at finding the firm swelling in front and the soft part behind; soon, however, I discovered that the vas deferens descended along the forepart of the cord, and that the epididymis lay in front. On the opposite side the parts were disposed as usual. The same inversion has been noticed occasionally in hydrocele (see following page).

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* This subject is more fully discussed in the essay on HERNIA, in Vol. IV.

† Mr. Curling showed at the Pathological Society the undeveloped testes from a remarkably tall men, who had been through life almost hairless as regards the pubes, chin, and whiskers. Both testes were quite undeveloped, and though normal in structure, had not advanced beyond the state of early childhood. The man had never shown signs of any virility. He had not been deficient in intellect; *Med. Times and Gaz.* vol. xx. p. 76; *Trans. of Path. Soc.* vol. xi. p. 157. Several instances have been recorded where the testes and other parts of the genital apparatus had not attained their proper development and position in idiots and others of feeble mind. This, however, is not always, or even usually, the case. Indeed, we know that the organs are commonly well formed; and the sexual propensities, uncontrolled by the moral faculties, are a source of much trouble in the management of these persons.

HYDROCELE.

Of all diseases hydrocele of the tunica vaginalis testis is one of the most simple in its nature and the most easy of diagnosis and treatment. It consists merely in a preternatural accumulation of the fluid which naturally moistens the internal surface of the tunic. It is not of dropsical nature, and is not a usual attendant on dropsy; but is a purely local affection, the result of some change in the membrane, whereby the proper balance between secretion and absorption is lost. That change is probably of an inflammatory nature, or of the kind which some pathologists call irritation—that is, a condition akin to inflammation and easily passing into it. At any rate, it is often traceable to a blow or some cause likely to induce inflammation. Associated with the fluid we often find some of the ordinary products of inflammation, and it usually contains a larger proportion of the albuminous and saline constituents of the blood than are present in ordinary dropsical effusions. Sometimes fibrine is present, as indicated by spontaneous coagulation; or coagulation may be excited by the addition of a small quantity of the fibrine or red corpuscles of the blood.* Its specific gravity is about 1025; it contains rather less animal matter than serum, though more than the fluid of ascites or hydrothorax;† and there are sometimes blood-globules in various conditions, flakes of lymph, and, in elderly persons, fatty matters or particles of cholesterine floating in it. Now and then it is like milk;‡ on the whole, however, it is not very variable in its appearance or character. The quantity varies; usually it is under a pint, but sometimes amounts to several quarts. The hydrocele of Gibbon the historian is still, I believe, without a rival in this respect, the quantity removed by Mr. Cline in that case being six quarts.

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* Buchanan, in *Proceedings of Phil. Soc. of Glasgow*, 1845, Feb.; Schmidt, in *Reichert und Du-Bois Archiv*, 1861, p. 555; and Virchow, *Die krankhaften Geschwülste*, p. 157. See also *Natural History Review*, April 1864, p. 160.

† Marcet and Bostock, in *Med.-Chirurg. Trans.* vol. ii. p. 374, and vol. iv. p. 73. Simon's *Animal Chemistry*, by Day, vol. ii. p. 495.

‡ In a case of this kind reported in *Path. Trans.* vol. xvi. p. 184, the milky appearance was due to the presence of fatty matter, which had probably been secreted from the tunica vaginalis.

There is commonly little change beyond the distension of the tunic caused by accumulation of the fluid. There is no vascularity, nor much thickening either of the sac or of the tissues external to it. Even the cremaster muscle undergoes little change; sometimes its fibres are rather coarse, more frequently they are thin and pale. The swelling has much the form which the tunic assumes when it is artificially stretched, after death, by the inflation of air, or the injection of fluid into it; that is, it is pyriform, with the large end downwards, and there is often a transverse constriction near the upper end. This constriction, which is also due to the shape of the tunic, as may be proved by blowing air into it, has often led to the supposition that there were two distinct sacs, or that there was a hernia in addition to the hydrocele.*

The *position* of the *testicle*, with regard to the tunic, regulates its position in the hydrocele: it is accordingly found at the lower and hinder part. The exceptions to this are few, and are commonly due to some change having taken place in the tunic, some unequal thickening of it coats, or adhesion of its surfaces, whereby the shape of its cavity is altered. Or there may have been congenital inversion of the organ, the epididymis presenting in front; in which case the testicle will be at the lower and *fore* part of the hydrocele.† Sometimes the testicle is in front, and we cannot quite account for the anomaly. As these varieties occasionally occur, the position of the testicle should in each be ascertained, if possible, before puncturing the hydrocele. For want of this precaution, I have, more than once, known the testicle pierced by the trocar, which was then either withdrawn or pushed on through the testicle into the hydrocele. No ill effect, beyond ecchymosis and slight inflammation, followed in these cases; but severe inflammation has followed this mistake in other instances. In children the testicle is said to occupy a lower relative position in hydrocele than in adults.

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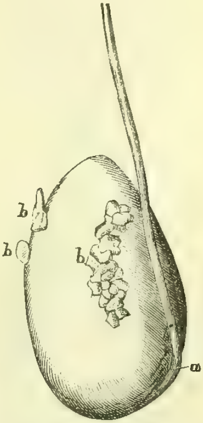
* Sir B. Brodie (*Med. Gaz.* vol. xiii. p. 91) relates a case in which this 'hour-glass contraction' increased so as to divide completely into two chambers a hydrocele which had been originally single.

† In a patient, aged thirty-six, who died of phthisis, I found a hydrocele on the right side, of about the size of a pear. The part was turned round, so that the testicle with the epididymis and vas deferens presented in front. The walls of the hydrocele were thick and opaque, with straw-coloured calcareous plates and ridges upon its inner surface and in its substance. The body of the testicle was quite flattened, but of its usual size.

Condition of testicle.—Usually the testicle is sound, retains its natural size, is placed vertically, and projects into the cavity, so that it cannot be distinguished by manipulation, unless the walls of the sac are flaccid. The sensations of the patient, when it is touched, are some guide to its position, but must not be relied on. Sometimes it becomes flattened and spread out by the pressure of the fluid, and by the stretching to which it is subjected in common with the rest of the walls of the sac. The epididymis is then elongated, and the pouch which naturally exists between the testicle and the epididymis, is obliterated. Sometimes, on the contrary, the testicle becomes separated from the hinder wall of the sac by an increase of the pouch just mentioned. This pouch, which projects towards the inner side of the testicle, may be so enlarged as to form a second sac, communicating with the larger sac by a neck, bounded in front by the testicle, and behind by the epididymis. Or the testicle may be projected into, even across the hydrocelic cavity, and, together with the structure connecting it with the epididymis, may form a septum dividing the sac, more or less completely, into two compartments. When this occurs, an alteration usually takes place in the axis of the testicle, so that it lies transversely, and the septum is also transverse.

Fig. 323.*



Hydrocele with pouch-like projections (*b*, *b*, *b*,) of the tunica vaginalis; *a*, testicle.

Other varieties occur in hydrocele. The sac may yield unequally, causing the shape to be more elongated or more spherical than usual; or circumscribed portions of the sac, yielding in a greater degree than the rest, may give rise to pouch-like dilatations, forming 'bilocular' or 'multilocular' hydrocele.

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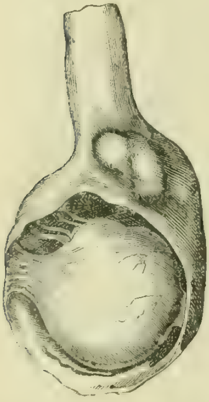
* This, and all the other drawings in this essay, are taken from specimens in the Pathological Museum of the University of Cambridge.

Not long ago I dissected a hydrocele, which was covered all over with small pouches, communicating with the interior by narrow necks. Small cysts may be developed in the wall of the sac.*

Usually the wall of the sac remains thin and transparent for a long period, even though it is subjected to repeated tappings. Sometimes, however, especially if there have been an injury or effusion of blood into it from any cause, the tunica vaginalis becomes thick, opaque, and dense, even to cartilaginous consistence; and it may be the seat of earthy deposit. This may be uniform; or the interior of the tunic may be rendered uneven or knotty by projecting masses or lines and bands of lymph. Under such circumstances, the testicle becomes flattened, and perhaps wasted by the pressure of the contracting lymph upon it. The structure of the testicle is rarely injured or atrophied except in old hydroceles, where the tunic has become thickened or coated with lymph, and the fecundatory properties of its secretion appear not to be materially interfered with.† The effusion of lymph into the cavity may also lead to obliteration of parts of it, causing alterations in its shape, or adhesions between its surfaces at certain points, and to the formation of septa, dividing the sac into two or more compartments. These changes are probably, in most instances, consequent on the injection of irritating fluids into the cavity for the purpose of effecting a cure, which has only partially succeeded.

FIG. 324.



Hydrocele with adhesions of tunica vaginalis.

Tubular prolongation to abdomen.—The occasional persistence of a tubular communication between the cavities of the tunica vaginalis and the peritonæum, constituting what has been called 'congenital hydrocele,' should also be borne in mind, and care should be taken in each case to ascertain whether it be so before injecting irritating fluids into the sac. Especially should this be done in children; and where there is hydrocele on both sides, in them, the suspicion of such a communication should always be entertained. An examination of the cord, and pressure upon the hydrocele, will usually decide the point, forasmuch as the fluid can be pressed from the tunica vaginalis into the abdominal cavity, and returns when the pressure is remitted. In this respect it resembles hernia, but there is not much difficulty in distinguishing between the affections. Besides being transparent, the swelling usually returns to some extent, although the patient be recumbent; and if the sac be emptied, it will gradually refill when the patient stands up, although the finger be pressed upon the inguinal canal with sufficient force to prevent the passage of a hernia. It must be observed that occasionally the tube connecting the hydrocelic cavity with that of the abdomen is so narrow as to escape detection when the cord is held between the finger and thumb; and it may even be so narrow as to permit the fluid to trickle very slowly from the hydrocele into the abdomen, so that its passage from one cavity to the other would escape observation on a cursory examination. There is a specimen of this kind in Guy's Hospital Museum. In such a case pressure upon the hydrocele, unless it is long continued, will make very little impression; and the nature of the case is likely not to be detected unless it have been remarked that the swelling is diminished when the patient has lain down some hours. Such cases, it is true, are rare; and I do not know of any in which mischief has resulted from the communication being overlooked, though I suspected it in one instance.

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* Museum of College of Surgeons, 2327.

† *Med. Times and Gazette*, Nov. 6, 1869, p. 542.

In each of the following cases it would seem that the canal remained pervious, except quite at the upper end; and that when hydrocele took place the sides of the canal yielded where it passed through the abdominal wall, and were also dilated into a considerable pouch behind the abdominal wall.

Case I. A man, aged thirty-five, had large hydrocele on the right side, with the usual transverse constriction near the upper part. It extended up to the inguinal ring, and received an impulse when he coughed. Examining the abdomen, I found a fluctuating swelling at the lower part, like a distended bladder; and a distinct impulse was communicated from this to the scrotal swelling, so that it was clear there were two sacs, one in the scrotum, the other in the abdomen, communicating through the inguinal canal. The history was obscure. The patient was unconscious of any swelling in the abdomen, yet had worn a truss for supposed rupture. The scrotal swelling was attributed to a blow on the pommel of a saddle ten years before. It had gradually increased. A trocar passed through the scrotum gave vent to seven pints of serous fluid, emptying both sacs. The testicle lay at the inner and upper part of the scrotum. Pain and swelling of the left lower limb, with other indications of plugging and inflammation of the femoral vein, followed. These subsided, and the fluid was on three subsequent occasions drawn off. A more radical proceeding being desired, I made an incision into the swelling, and carried it up to the internal ring, so that there might be a free vent for the products of inflammation from the abdominal sac; then inserted lint. Suppuration ensued; and when the wound healed, the cavity was obliterated in its whole length.—Case II. A man, aged twenty-nine, had hydrocele on the right side, extending through the inguinal canal into the abdomen, and causing a fulness above the internal ring. It resembled a hernia in its shape, in the impulse received by coughing, and in the fact that the testicle could be felt, apparently distinct from it, at the lower part; but it was transparent and fluctuating. It was attributed to a blow received ten years previously, and was said to have commenced in the scrotum. There was inguinal hernia on the opposite side. I cut into the swelling cautiously; and as the abdominal swelling was smaller than in the preceding case, I did not carry the incision so high, but passed lint along the canal into the abdomen. Suppuration followed, and the disease was cured.*

Diagnosis of hydrocele.—The position and shape of the swelling, its termination below the external ring, so that the cord may be felt free above it, its lightness and fluctuation, and, above all, its transparency, furnish such ready means of diagnosis in the great majority of cases, that a mistake does not often occur. Still, as the requisite means of informing himself are so simple, the surgeon should not neglect to employ them in every case. Especially should he be careful to ascertain whether the swelling is transparent, not only on the first time of using the trocar, but also on each subsequent occasion on which he is called upon to puncture the swelling; and in making this examination he should be careful to press the swelling to the fore part of the scrotum between the fingers and thumb of one hand, so as to render the skin quite tense over it, while he screens his eyes from the light with the other hand placed over the scrotum. In a doubtful case I place the patient upon a table near a window, and use as a screen, in addition to my hand, a dark cloth, carefully adjusted over the upper surface of the swelling and covering my head. These precautions are necessary to avoid error. Assistance may sometimes be gained by looking through a stethoscope or tube. Transparency is a pretty sure indication of the presence of serum or other light-coloured fluid, and is therefore a tolerably safe warrant for the use of the trocar. I have carefully examined hernia and other swellings for the purpose of ascertaining how far transparency may really be relied upon as an evidence of the presence of hydrocele or watery cyst in the scrotum, and have not found it to fail. That is to say, every swelling which has transmitted the light of a candle or the sun has proved to contain light-coloured fluid. Even in the hernia of young children, where the bowel and its coverings are thin, the light of a candle placed close to the part fails to shine through.

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* Professor Syme relates a case of 'abdominal hydrocele' in a child aged four or five. The fluid was contained, not in the tunica vaginalis, but in an expansion of the cord. · *British Medical Journal*, 1861, p. 139. The dissection of a similar case is given by Mr. Lister, in *Edinburgh Medical Journal*, September 1856.

Though transparency is thus a most valuable positive indication, yet the negative evidence afforded by its absence is by no means equally conclusive that the swelling is not of the nature of hydrocele; for the admixture of a small quantity of blood with the fluid will entirely prevent the transmission of light; and a considerable increase of the thickness of the sac may have the same effect. Under these circumstances, the diagnosis is more difficult, and may perhaps not admit of being satisfactorily established without making a puncture with a grooved needle or a trocar, or an incision. Such a hydrocele, extending into the inguinal canal, so that its upper end cannot be defined with the finger, and so that it acquires an impulse from coughing, simulates hernia very closely. The history of the case, indicating whether the swelling commenced in the scrotum, and ascended to the groin, or in the groin, and descended to the scrotum, may assist in the diagnosis. The patient should be examined in bed, to ascertain whether the recumbent position causes a diminution of the swelling. In non-congenital hernia, moreover, the testicle may usually be felt at the lower part of the scrotum, which cannot often be done in ordinary hydrocele. In a doubtful case it would be more prudent to cut cautiously down to the part than thrust either a trocar or a grooved needle into it.

The two affections, hernia and hydrocele, are not unfrequently combined; and the hernial swelling may come into contact with the hydrocele, so as to communicate to it the impulse received in coughing. The nature of the case may usually be ascertained by examining the patient in the recumbent position. The contiguity of the hernia need make no difference in the treatment of the hydrocele, for the inflammation excited in the latter by injections or other means is not likely to extend to the hernia. The hernia may not only reach the hydrocele, but may descend into the scrotum in front or behind the hydrocele, or on one side of it. Sometimes the hernial sac, with its contents, has projected into the hydrocele. Out of six cases of this kind which M. Dupuytren witnessed,* he only twice saw symptoms of strangulation resulting from constriction of the organs at the place where they were engaged in the serous pouch of the testicle.

The distinction of a non-transparent hydrocele from hæmatocele, cystic and other tumours of the testicle, is sometimes quite impossible without resorting to the aid of a trocar or an incision. An incision is usually to be preferred, because more information is obtained by it, and because, if the swelling turn out to be a hydrocele with thickened sac, a free incision, followed by suppuration, is, on the whole, the best treatment. The following case is an illustration of the difficulties occasionally met with in the diagnosis of hydrocele.

A man, aged forty-five, had swelling of the left testicle as large as a cocoa-nut, heavy as if it were solid, and with indistinct feeling of fluctuation; not the slightest transparency; slight constriction near the middle; large tortuous veins upon its fore part; the cord healthy. He said that twenty years before he received a sabre-wound, which left the testicle about twice its natural size, and it remained so till October 19, 1860, when he had a blow, after which the part became swollen and painful. The swelling continued, and the case was supposed to be hæmatocele. Yet on November 2 a trocar gave vent to twelve ounces of the ordinary straw-coloured fluid of hydrocele, and the sac was found to be much thickened.

Hydrocele appears on each of the two sides of the scrotum in about an equal number of cases, and is most frequent between the ages of thirty and fifty. It is also common in elderly persons.† It usually forms slowly, and is painless, being inconvenient only from its bulk and weight. In some cases, however, it is attended with a good deal of pain. I have observed this to be so when the fluid is re-accumulating after tapping more frequently than when it is collecting for the first time. Sometimes the hydrocele is a remnant of an acute inflammatory attack in the epididymis, or is an attendant upon inflammatory or other disease in the testicle. Under such circumstances lymph is usually mingled with the serum; and when the disease subsides, the fluid is commonly absorbed, though the lymph often remains, and causes adhesions between the surfaces of the tunic.

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* *Medical Gazette*, vol. xii. p. 686.

† It seems that other alterations in the tunica vaginalis are also common in advancing years. Dr. Duplay (*Archives générales de Médecine*, août 1855, p. 132) gives an account of the examination of these parts in 59 persons, whose ages ranged from sixty to eighty-six. The tunica vaginalis was more or less altered in 44: in 12 it was thickened; in 17 there were adhesions; in 15 there was hydrocele; and in 4 cartilaginous or osseous bodies hanging by narrow pedicles.

Treatment.—Although the morbid condition upon which the accumulation of the fluid depends must be of the faintest possible kind, yet we know of no means by which it can be arrested and the resorption of the fluid induced. All the measures we are in the habit of adopting with the view of checking secretion or promoting absorption are valueless, or nearly so, in this instance. Mercury and iodine, whether given internally or applied outwardly, vesicatories or pressure, however carefully employed, are almost invariably useless. The swelling slowly continues in spite of them; and if limited at all, is so only by the resistance of the surrounding tissues to further distension. In this respect, it is true, hydrocele is but an example of a class. In other diseases of the like kind—hydrocephalus, hydrothorax, hydrops articuli, &c.—the morbid change determining the accumulation of the fluid is slight, almost inappreciable, and the resistance to remedies is as great, or nearly as great, as in hydrocele.

Happily this feature is of no great importance in the cure of hydrocele; and we should not have much inducement to persevere with treatment of this sort, even if it were much more effectual than we know it to be; for the removal of the fluid by a trocar is so simple, quick, and painless a proceeding, that we do not hesitate to resort to it as soon as the swelling has become a source of inconvenience. An interspace between the veins should be selected where the sac is transparent. The lower and fore part is usually chosen; and the point of the instrument should be directed upwards to avoid wounding the testicle. There is no advantage in incising the skin with a lancet before introducing the trocar, or in placing any plaster or other dressing upon the wound afterwards. I have never known any bad result to follow the tapping, though my patients are often obliged to walk some miles to their homes immediately after the operation. That some risk, however, attends upon it is shown by cases in the practice of Sir A. Cooper, Mr. Curling, and others, where sloughing of the scrotum has followed, and has even proved fatal. In some instances effusion of blood into the sac, from a wounded vessel, forming a hæmatocele, has taken place.*

The relief afforded by tapping is, however, only temporary. The fluid is almost sure to collect again, and, in all probability, it will be necessary to repeat the operation in the course of a few months. The patient may be content with the relief afforded by periodical tappings, or may be unable to spare the time requisite for effecting à cure. Should this not be so, it is well at once to inject into the emptied sac, through the canula, some fluid which is calculated to excite smart inflammation of the tunic; it being found by experience that this will, in most cases, lead to a cure. Many fluids have been tried—port-wine, solution of sulphate of zinc, &c.—the mode of action of all being the same; and they, or the chief part of them, are allowed to return through the canula after a period varying from a few minutes to half-an-hour. The most convenient plan, and the one which, from the small proportion of failures, seems to deserve its present popularity, is to throw into the sac two, three, or more drachms of the tincture or some solution of iodine, and to allow it to remain. While the canula is being withdrawn, after the injection, the sides of the sac should be nipped between the finger and thumb to prevent the escape of the iodine from the sac; and the scrotum may be shaken a little roughly, so as to insure the contact of the fluid with all parts of the interior of the sac.†

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* Mr. Davey (*British Med. Journal*, 1857, p. 593) relates that he tapped an enormous hydrocele, hardly smaller than the body of a robust child, and removed a washhand-basinful of serous fluid. His intention was to remove the contents by instalments, so he repeated the operation a few days after. This was followed by violent inflammation of the scrotum and contiguous parts, threatening general sloughing of the scrotum. Many and deep punctures were, however, made, followed by fomentation; the inflammation and swelling gradually subsided, and the hydrocele was cured.

† Mr. Davey (*British Med. Journal*, March 15, 1862) appears to attribute his success in the treatment of numerous cases of hydrocele in Ceylon, with an injection of sulphate of zinc (2 grs. to 1 dr.), to his being in the habit of kneading the scrotum for a minute or two, so as to bring the zinc with some force into contact with the whole interior of the sac.

In the same journal (February 22, 1862) is the account of a case of hydrocele in an elderly man tapped and injected with three drachms of turpentine. More inflammatory action than necessary followed, with suppuration in the scrotum, and a cure.

Now and then the mere rubbing together of the surfaces of the tunica

The inflammation following the injection of a hydrocele is not confined to the tunica vaginalis, but extends to the cellular tissue and skin of the scrotum, and usually to the epididymis. I think iodine has the advantage over the other fluids just mentioned, in that the inflammation excited by it is more moderate and uniform in degree; it is rarely very severe, yet generally sufficient for the purpose. The patient had better rest in bed for a day or two, but need seldom be confined longer; and it is rarely necessary to resort to any additional measures for increasing the amount of inflammation, such as rubbing the sides of the sac together, or irritating the skin. The inflammation and swelling subside spontaneously. Some enlargement and hardness may remain for weeks, or even for months, but it is usually of no consequence. We need not despair of a cure, though the inflammation be very slight; for in some cases, in which scarcely any pain or swelling followed the injection, the hydrocele has not returned. In some the fluid has re-collected, so that the part was in much the same condition as before the operation, and then has gradually been absorbed. It is well, therefore, to wait for a considerable period before resorting to any further treatment. The cure is usually permanent, though in a few instances the fluid has returned after a lapse of some years.

We learn by dissection that the inflammation consequent on the injection of iodine, or other stimulating fluid, for the cure of hydrocele, is attended commonly with the effusion of lymph upon the surface of the tunica vaginalis, and of fluid into the cavity of the tunic. The fluid is tinged with blood; hence, if the part be examined a few days after the injection, though there may be a good deal of fluid in the sac, it will seldom be found translucent. Subsequently, as the fluid becomes absorbed, the opposed surfaces of the tunic come into contact, and are, more or less, united by lymph. The adhesion may be general, so that the cavity is quite obliterated, or filled up by the fine areolar tissue into which the lymph, in course of time, becomes converted; or the adhesion may be partial, leaving spaces in which fluid may still collect; or it may be confined to a few bands or threads connecting the surfaces. Lastly, the lymph

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vaginalis, after the complete evacuation of the fluid, has been followed by sufficient inflammation to effect a cure. This simple method, however, will not often succeed.

may be in such small quantities, or may be so nearly absorbed, as to leave the membrane pretty much in a natural state. This has been found in some cases in which the hydrocele has been cured; so that it would seem the mere passing of inflammation upon the membrane may induce such a change in it as to prevent the reaccumulation of the fluid.* Very rarely does the inflammation proceed to suppuration. Sir B. Brodie has known it to do so in three cases, and Mr. Curling in one.

Although ill effects rarely follow the injection of hydrocele, it is not worth while to run the risk of exciting inflammation in a very large sac; when, therefore, the fluid exceeds a pint, it is advisable simply to tap the sac, and on a subsequent occasion again to draw off the serum before so large an accumulation has taken place. The injection may then be resorted to with comparative safety.

The presence of some disease in the testicle, even though it be the cause of the hydrocele, does not necessarily constitute an objection to tapping; indeed, much relief may sometimes be given by drawing off the water. It is not, however, advisable to inject the sac under these circumstances; *first*, because the inflammation so caused is likely to aggravate the disease in the testicle; and, *secondly*, if the disease in the testicle subsides, the hydrocele commonly disappears spontaneously. Occasionally, after tapping a hydrocele, we find the testicle somewhat enlarged and indurated, in consequence of chronic inflammation which has taken place in the body of the gland, or in the epididymis; and the question arises whether this constitutes an objection to the radical treatment of the hydrocele. If the enlargement be considerable, the part tender, and the hydrocele recent, the proper practice is to wait for a time, and, under appropriate treatment for the disease of the testicle, the enlargement and the hydrocele will probably disappear altogether; but if the hydrocele be of some standing, and the affection of the testicle slight, there is no objection to injecting the sac.

Acupuncture causes a temporary diminution of the swelling, the fluid passing through the openings made by the needle into the areolar tissue of the scrotum, where it is absorbed. It is not to be relied on as a means of cure, for the fluid usually recollects as soon as the punctures in the sac have healed, though it is thought to do so less quickly than when the trocar has been used.

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* In sixteen cases successfully treated in various ways, M. Hutin found the cavity of the tunica vaginalis quite obliterated in eight; the adhesions of its surfaces were only partial in four, and in four there were no traces of them. *Arch. gén. de Méd.* cinq. série, tome ii. p. 218.

In several instances I have tried the plan of inserting a little *nitric oxyde of mercury* upon a moistened probe passed through the canula, after the fluid had been evacuated. It commends itself by the facility with which it is done, and it is very successful. The inflammation which it excites is, however, more severe than that caused by iodine; and in two cases in my own practice this treatment was followed by salivation. I have therefore ceased to adopt it. I have found the wire seton open to the objection made to it by others, viz. that it is liable to be followed by troublesome suppuration.*

An incision into the sac, the wound being kept open so as to cause suppuration, is an effectual method, though unnecessarily severe for ordinary cases. It confines the patient to bed for some time, and is not altogether unattended with danger. The inflammation which follows is sometimes very acute, and accompanied by a good deal of constitutional disturbance. In Guy's Hospital Museum is a specimen of tunica vaginalis said to have sloughed away under these circumstances. The procedure is suited to the cases in which the sac is thickened, and in which an exploratory incision is required to ascertain the real nature of the disease; also to cases in which milder means have failed. In two of the instances in which I have resorted to it, plugging and inflammation of the veins of the lower limb ensued, but were productive of no permanent ill effect.†

Spontaneous cure, though common in infants, is very rare in after-life; so rare that the prospect of it is not worth taking into account. It has happened from a blow,‡ or a violent effort in coughing, and during a fit of the gout, from inflammation of the tunica vaginalis, and, gradually without any apparent cause.*

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* See Dr. Gillespie, *Edin. Medical Journal*, January 1862. The conclusion to be arrived at from a paper and discussion at the Edinburgh Med.-Chir. Society is, that the effects of the wire seton are very uncertain. In some cases little or no inflammation is induced, in others severe suppuration. *Edin. Medical Journal*, vol. vii. p. 1074.

† For an account of other modes of treatment, see Curling, *On Diseases of the Testis*.

‡ *Pott's Works*, by Earle, vol. ii. p. 292. In other cases, where the swelling has disappeared after a blow, and the patient has thought himself cured, he has been disappointed by the return of the fluid.

Infantile hydrocele is very common. It generally takes place after the communication with the peritoneal cavity has been obliterated, but may appear before. It is easily recognised, owing to the thinness of the coverings giving ready transmission to light. It usually subsides spontaneously, and needs, consequently, little attention. The cure may perhaps be quickened by stimulating the skin with iodine or zinc lotion, or by puncturing the sac with a needle in two or three places. In considering the advisability of any more active treatment the probability of a communication with the abdominal cavity is to be borne in mind (p. 84).†

ENCYSTED HYDROCELE.

Cysts are very often found in connection with the testicle; and a good deal of pathological and practical interest attaches to them. They have received the careful attention of able anatomists and surgeons, and have been the subjects of several essays,‡ and are numerously displayed in our museums; but their origin and nature still remain to be clearly made out.

They may most conveniently, if not most correctly, be thrown into two groups—the *small* cysts and the *large*. Those included in the former group seldom or never attain to a greater size than a pea, are of very simple nature, commonly do not attract attention during life, and do not require treatment; whereas those in the second group may attain to indefinite magnitude, and become, therefore, objects for diagnosis and treatment. Some of these are also less simple in their nature and contents.

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* Brodie, in *Medical Gazette*, vol. xiii. p. 90.

† Dr. Linhart (*Frorieps Notizen*, 1856, vol. ii. No. 4; *Brit. and For. Med. Rev.* July 1856) recommends in such cases subcutaneous incision of the tunica vaginalis, which allows the fluid to become effused into the scrotum, where it is rapidly absorbed. M. Richard (*Gazette des Hôpitaux*, 1857, No. 41, and *B. and F. Med. Rev.* July 1857) removes the fluid with a very small trocar, and then injects a small quantity of alcohol, an assistant compressing the track of the inguinal canal for a minute or two; experience having shown that the persistence of the communication with the abdomen is not of the importance that might have been expected.

‡ Brodie, in *Medical Gazette*, vol. xiii. p. 137. Gosselin and Duplay, *Archives générales de Médecine*, 4ᵉ série, tome xvi. pp. 24 and 163; and 5ᵉ série, tome vi. p. 139. Liston, Lloyd, and Paget, *Med.-Chir. Trans.* vols. xxvi. and xxvii. Luschka, *Virchow's Archiv*, vol. vi. p. 310. Curling, *Diseases of the Testis*, p. 130, &c.

The *small cysts* are found in as many as a half of the testicles examined after the age of forty. They are rarely met with before puberty. They lie immediately beneath the serous coat of the epididymis more frequently than on the body of the testicle. When they occur upon the latter, they are situated between the tunica vaginalis and the tunica albuginea; when on the epididymis, they are situated, apparently, between the tunica vaginalis and the proper investing fibrous coat of the part. Thus they seem to be related rather to the serous or subserous tissue than to the organ itself. They may be dissected clean out without interfering with the tubular structure; and no communication can be shown to exist between them and the tubules. Each has a proper fibrous tunic of its own, and contains clear fluid, in which are simply granules and epithelial scales, with occasionally small crystals—never spermatozoa or other spermatic elements. They may be single or in numbers. Sometimes they appear as mere points beneath the membrane; sometimes they cause slight elevations of it; and sometimes they project it till they acquire a polypose form, and hang into the cavity of the tunica vaginalis. Their pedicles may become long and narrow, and may even give way, leaving the cyst free in the cavity. Possibly the small fibrous, cartilaginous, and calcareous bodies occasionally found in the cavity of the tunica vaginalis originate in these small cysts, which have become detached, and have solidified and undergone other changes while lying loose in the cavity. Sometimes they burst, and, after having discharged their contents into the cavity, shrivel and are converted into small solid remnants. It is possible that the irritation occasioned by them may sometimes give rise to hydrocele. With this exception they are not productive of any symptoms or inconvenience, and do not come under the notice of the surgeon.

The *large cysts* are less common than the preceding, and are not limited in their size, having been known to contain twenty, and even forty, ounces. They are composed of a fibrous tunic, lined by delicate tesselated epithelium. Some of them contain only serous fluid, much resembling that of common hydrocele. In many of them, however, the fluid is paler than serum, more like water; or whitish, milky,* not quite transparent. It then commonly gives little or no evidence of albumen when it is heated; and when it is placed under the microscope it often shows spermatozoa and spermatic cells in greater or less quantity. When the fluid is fresh, the spermatozoa are often lively in their movements, and have been sometimes found to be abundant in the fluid removed from the cyst, although they existed scantily, or not at all, in the tubules of the testis and of the epididymis. Sometimes they are less active, or incompletely or ill formed. The presence or absence of spermatozoa may usually be determined by the character of the fluid, whether it be watery or serous. Accordingly, on tapping a hydrocele, if the fluid evacuated be watery or whitish, we may be pretty sure that it is of spermatic character, and that it was contained, not in the cavity of the tunica vaginalis, but in a cyst. We read, it is true, now and then, of spermatic fluid being withdrawn from the cavity of the tunica vaginalis, and it is possible that it may be so. The fact, however, has seldom been proved by dissection. The only instance of the kind that I am acquainted with is one described by Luschka; and the presence of the spermatozoa in the hydrocelic fluid was, in that case, shown to be due to the bursting of a cyst into the cavity of the tunica vaginalis.

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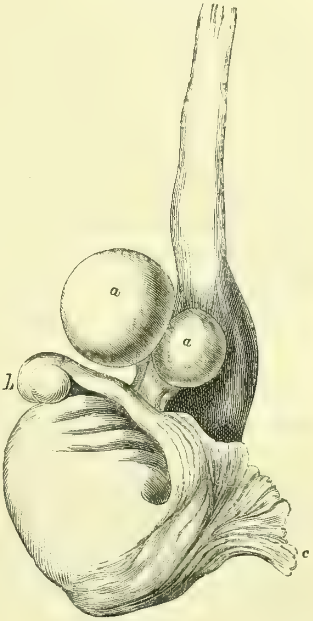
* The milky cysts do not always contain spermatozoa, and the white or faint yellow colour of the contents is probably due to the presence of fatty matter and granules.

Spermatozoa, then, with very rare exceptions, are peculiar to encysted hydrocele, but are not present in all cases of that disease. The question arises, what relation do they bear to the containing cysts? Is their presence merely accidental, consequent on a communication being formed between the cyst and one of the tubes of the epididymis by rupture of the latter from a blow or other cause? This view is taken by some pathologists. We must bear in mind, however, that such communications between secreting and other tubes with cysts, abscesses, or other sacs formed in their neighbourhood, very rarely occur. Certainly, our experience of such a process in other parts of the body does not warrant our looking to it for the explanation of so common an occurrence as the presence of spermatozoa in encysted hydrocele. Moreover, the other characters of the fluid (the absence of albumen, &c.) in these cases indicate that it is *sui generis*, and not a mere resultant of the addition of sperm to the fluid of an ordinary cyst. Mr. Paget takes the view that the spermatic contents are a product of the cyst itself, and thinks that cysts seated near the organ, which naturally secretes the material for semen, may possess a power of secreting a similar fluid. To this, however, must be objected the improbability that so exact an imitation of a complex and highly-wrought secretion should take place in a cyst developed merely in areolar tissue, and unconnected with the secreting tissue of the gland. It is difficult to believe in such an approach to the spontaneous generation of spermatozoa after the developmental energies of embryonic life have passed away. One cannot help suspecting that the spermatic corpuscles of these cysts are the offspring of the spermatic corpuscles of the proper secreting tubes, and that the cysts themselves are, in some way or other, offshoots from those tubes. Luschka observed distinct communication between the spermatic tubes and the cysts in each of the cases examined by him; the opening of the tubes into the cysts being large enough to admit a bristle, and to permit mercury to pass from the tubes into the cysts, or *vice versâ*. Similar communications have been found by Curling and others. In other instances, however, equally careful observers have failed to discover any communication of the sort, or, indeed, any connection between the cysts and the tubules. They describe the cysts as possessing complete capsules of their own, invested all round by areolar tissue, which separated them from surrounding structures, and permitted them to be dissected away without any injury to those structures. It is quite possible that, in such instances, the cysts may have originated in the tubes and have lost their connection with them as growth went on. For the present, however, the question of the real origin of these sperm-bearing cysts must remain an open one.

Fig. 325.



Spermatic cysts. *a a*, closely connected with the upper part of the epididymis; *b*, spermatic cyst lying under the upper end of the epididymis and closely connected with the testis; *c*, tunica vaginalis reflected.

They are usually found in or near the epididymis, so near that they may fairly be presumed to have originated in it.* Sometimes two or more co-exist; and sometimes the whole epididymis is occupied by, or transformed into, a mass of cysts. Occasionally the spermatic cysts are associated with common hydrocele,† or with cysts which contain mere serous fluid. The latter are not always so closely connected with the epididymis as the former.

In a few instances large cysts have been found upon the tunica albuginea testis, between it and the visceral layer of the tunica vaginalis, or in the substance of the tunica albuginea; but I am not aware that spermatozoa have been detected in the cysts so situated.‡

Diagnosis.—Encysted hydrocele corresponds in its general features with ordinary hydrocele, being a light, fluctuating, transparent swelling, connected with the testicle. It differs from ordinary hydrocele in its relation to the testicle, being situated above or below it, or to one side, instead of enveloping it. Sometimes the cyst may be felt quite distinct from the organ, giving the impression of an additional testicle. As the cyst increases, the testicle is borne upon its wall, and may still often be recognised as a distinct substance, perhaps quite at the lower part of the swelling, more rarely on one side, above, or in front. This projection of the testicle may be the only means of distinguishing an encysted from an ordinary hydrocele; and it is by no means a sure one, for we sometimes find the same thing in common hydrocele, owing to adhesions or other cause. Sometimes the cyst projects into the sac of the tunica vaginalis, distending it in the same manner as if the fluid were contained in the cavity. Then, and under some other circumstances, it is impossible to tell whether the fluid be in a cyst or not; and it is no uncommon thing for the surgeon to be first informed of the nature of the case on finding the fluid evacuated by his trocar to be of the watery nature of encysted hydrocele instead of being the serous fluid of ordinary hydrocele.

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* This position has suggested that they may originate in some of the tubes of the Wolffian body, which have not become connected with the testicle, and which, therefore, remain as blind canals or sacs. Virchow, *Die krankhaften Geschwülste*, p. 282. This pathologist believes that, after a time, they may lose their spermatic character and become simple serous cysts.

† 'I tapped the lower hydrocele, and a yellow serous fluid was discharged; but still half the swelling remained. I then darkened the room, ordered a candle, and examined the swelling, which extended from the upper part of the testis to the abdominal ring. It was very transparent: I therefore tapped it, and drew off a fluid like water, quite free from colour, which contained some coagulable matter, but less than common serum.'—Sir A. Cooper, *On the Testis*, p. 170. This was probably a spermatic cyst, and such cases are not very uncommon.

‡ In *Trans. of Path. Soc.* vol. vii. p. 247, is the dissection, by Mr. Hutchinson, of 'a thick-walled cyst, size of a goose's egg, developed in the layers of the tunica albuginea, and by which the gland-structure itself had been displaced downwards.'

Treatment.—Happily the diagnosis between common and encysted hydrocele is not very important; for the treatment of the two is the same. The fluid should be evacuated when its quantity is such as to be a source of annoyance; and the sac may be injected with iodine. The prospect of a radical cure is not so good in encysted as in common hydrocele; but success has followed in a sufficient number of cases to encourage the adoption of this plan, and even to justify its repetition should the first trial fail. I am not aware that any ill consequences have ensued upon it. The palliative treatment of merely drawing off the fluid has this recommendation, that the fluid does not usually re-collect in the cysts as quickly as in common hydrocele. It should be observed that these cysts sometimes attain to a certain size, and then remain stationary for years; so that, unless they are increasing inconveniently, they may be left alone.

Hydrocele of the spermatic cord consists in the accumulation of fluid, which is usually of serous character, like that of hydrocele, in a bag in some part of the spermatic cord. It may be near the testicle, or near the internal ring, or at any intermediate point. It rarely attains to a larger size than that of a hen's egg. The bag is thin, and probably consists, in most instances, of an unobliterated portion of the canal of the tunica vaginalis, which has become distended by an accumulation of fluid in it. This view is entertained by most surgeons; and is supported by the fact that unobliterated portions of this canal may not uncommonly be discovered, by dissection, in young persons and in adults. The hydrocele is usually oblong, its long axis corresponding with that of the cord; it is surrounded by the loose areolar tissue of the cord, which admits of its being easily dissected away. Sometimes, probably, an independent cyst is formed, constituting *encysted hydrocele of the cord;* but the two conditions are not distinguishable from one another during life, even if they be on careful dissection. They need not, therefore, be considered separately.*

Diagnosis.—The sac and its contents are commonly transparent. This may be ascertained by fixing the sac in a particular position, stretching the skin tightly over it, and adjusting the light carefully; and it is often the only means of distinguishing the disease from hernia and other swellings. When the sac is situated below the external ring, and can be felt as an oval, defined, fluctuating swelling, there is no difficulty. But when the sac is higher, and, in consequence of the laxity of the investing tissues, can be slipped to and fro in the inguinal canal, ascending in the recumbent, and descending in the erect posture, and acquiring an impulse from coughing, its nature can be recognised with certainty only by its transparency.

The following cases indicate some of the points of difficulty in the diagnosis of this affection:

A man, aged thirty-five, had swelling above the right testicle (which was rather indurated), extending along the cord, through the inguinal canal, to the abdomen. It felt like a hernia, and received a distinct impulse when the patient coughed. It did not, however, diminish in the recumbent position; it was said to have followed a blow upon the pommel of a saddle; and, when examined by the aid of a candle, it was found to be transparent. I introduced a trocar and drew off six ounces of straw-coloured fluid. The swelling partially returned, but subsided under the external application of iodine, and there was no trace of it two years afterwards.

Compound spermatic cyst.—A youth, aged nineteen, had a swelling on the right side of the scrotum, closely connected with the upper and fore part of testicle. Fluctuation could be perceived in it, and transparency when the skin was stretched tightly over it. Above this, at the external ring, was a small soft swelling, doughy, not distinctly fluctuating. Like a hernia it went up into the abdomen, quite out of reach, when he was laid down, and returned again when he stood up or coughed. It also communicated an impulse to the finger when he coughed. He wore a truss, which had been ordered by an experienced surgeon at a hospital; and it was thought to be a case of hernia by most of those who examined it at our hospital. I was induced to examine more carefully by observing that the impulse was less distinct than it usually is in hernia. Moreover, when he stood and coughed, the swelling seemed to bolt past my finger and thumb, which, with a little pressure, met together above it; and I thought I could press it to and fro, as though it were a distinct cyst or tumour, and not a swelling prolonged into the abdomen. When he was laid down, and the swelling had disappeared, it could be brought into view, and even brought beyond the external ring, by traction upon the cord. When thus pulled down, with the skin drawn tightly over it, the light of a candle could be seen through it. I accordingly cut down carefully through the cremaster, which was unusually distinct, and the other coverings, and exposed a sac, in which we could perceive that there were membranous contents capable of being moved about, and we could see vessels upon them. They looked and felt like omentum or intestine in a hernial sac. I again had recourse to the candle, and finding that the swelling was quite transparent, and that its contents could not be returned into the abdomen while the cord was fixed, I opened the sac, giving vent to some clear fluid, and exposed several thin-walled cysts, bearing vessels, and containing clear fluid. Some were as large as a bean, the others were smaller. They were connected together and with the upper part of the cyst, which proved to be a closed sac unconnected with the abdomen. I cut away the mass of cysts with a portion of the containing sac; and then opened the lower and larger swelling, which appeared to be formed by a portion of the tunica vaginalis distended with fluid. Suppuration ensued, the wound healed up, and the lad recovered.

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* Mr. Gamgee examined in the Pathological Museum of the University of Pisa, the calcified cyst of a hydrocele of the human spermatic cord of about the shape and size of a hen's egg. *Surgical Researches,* p. 193. In several instances blood has been found in the cysts of the cord.

Hydrocele of a hernial sac containing omentum.—A man, aged fifty, was the subject of supposed incarcerated hernia. He had suffered from rupture many years; used to return it when it descended, and perceived a gurgling in doing so; had worn a truss. A week previously to my seeing him, it came down and was painful; and, as he could not return it, he applied to a surgeon, who made many ineffectual attempts to reduce it, and, failing, kept him in bed on low diet. The swelling presented the appearance of an inguinal hernia, was larger than a goose's egg, with a narrow neck extending up the inguinal canal—so narrow that I thought it could scarcely be traversed by intestine. Accordingly, I examined the swelling with a candle, and found it transparent. There being no urgent symptoms, I directed the patient to get up and take some aperient medicine and his usual diet. A fortnight after, the swelling remaining the same, I introduced a trocar and drew off four ounces of straw-coloured fluid. There remained in the sac a long firm substance extending up the inguinal canal and feeling like a piece of omentum. The fluid re-accumulated, and the swelling was a source of great annoyance; so I made an incision into it. It proved to be a hernial sac containing a strip of omentum and four ounces of serous fluid. There was no communication with the abdominal cavity. The sac was left open, suppuration ensued, and the man quite recovered.

Transparent swelling in and near the inguinal canal proving to be abscess.—A young woman had a fluctuating swelling, as large as a turkey's egg, over the region of the right external inguinal ring, extending towards the pubes in the one direction, and along the course of the inguinal canal in the other. It was seen to be transparent when examined with a candle, and was thought possibly to be a cyst or collection of fluid in the canal of Nuck. It had commenced two years previously, was gradually increasing, and was a source of much inconvenience. I made a careful incision into it, and gave vent to a quantity of serum, followed by thin pus and masses of soft white lymph. It was evident that the pus-corpuscles and the lymph had subsided to the bottom of the abscess as the patient lay in bed, and had left the exposed part full of serum only and, therefore, transparent. A free vent was given to the pus; gradually the discharge ceased, and the part healed.

The *diffused hydrocele of the spermatic cord* described by Pott and Scarpa, and appearing to consist in a simple and local œdema of the cord, I have never seen; nor can I make out that any cases of the kind have fallen under the observation of modern surgeons. At any rate it is a very rare affection; and it is sufficient to refer to the account of it given by the authors just mentioned.*

HÆMATOCELE

consists in an effusion of blood, either into the cavity of the tunica vaginalis, or into a cyst connected with the testicle or the cord. We have, therefore, 'hæmatocele of the tunica vaginalis,' 'encysted hæmatocele of the testis,' and 'hæmatocele of the spermatic cord.' It is usually caused by a blow, and not unfrequently supervenes upon hydrocele, common or encysted. The source of the blood, in such case, is some ruptured vessel or vessels in the tunica vaginalis, or a small wound penetrating the tunica vaginalis.† It may also follow a wound of a vessel caused by the trocar in tapping a hydrocele. The quantity and condition of the blood vary a good deal. Sometimes there is only sufficient to tinge the fluid, and to deprive it of its transparency. Oftener there are clots mingled with the fluid; sometimes it is pure blood. Occasionally the coagula are arranged in layers, as in an aneurismal sac;‡ and the blood may be in various stages of degeneration.

In hydrocele, as has been remarked before (p. 82), the containing tunic usually retains its tenuity and its transparency for a long time, and perhaps never alters. This is not so in hæmatocele. An early effect of the presence of the blood is to cause some inflammation and thickening of the tunic, whether it be the tunica vaginalis or the wall of a cyst. This thickening often proceeds to a considerable extent, amounting, it may be, to nearly an inch, and sometimes affects the surrounding areolar tissue, which becomes condensed and adherent to the tunic. In hæmatocele of the tunica vaginalis the thickening affects the visceral as well as the reflected portion of the tunic, and may extend to the tunica albuginea; but the substance of the testicle remains healthy, unless indeed it be subjected to atrophy in consequence of the pressure exerted upon it by the blood or by the contraction of the thickened tunics. Lymph also may be effused upon the internal surface of the tunica vaginalis and be, there, mingled with the clotted blood.

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* Pott, 'On the Hydrocele of the Cells of the Tunica Communis,' in his *Chirurgical Works*, by Earle, vol. ii. p. 224. Scarpa 'Sull' Idrocele del Cordone Spermatico,' in his *Opuscoli di Chirurgia*, vol. i. p. 137. Mr. Flower (*Med. Times and Gaz.* vol. xvii. p. 109) describes a case of diffused hydrocele, below the testis, of the gubernaculum testis; the testicle was retained in the inguinal canal.

† 'A man was brought into Guy's Hospital who had long had a hydrocele, and had received a severe blow upon it, which suddenly increased the swelling, bruised the scrotum, and produced great pain from distension. I immediately made an incision into it, and discharged a large quantity of water and coagulated blood; and found a rent in the tunica vaginalis between one and two inches in length, and covered with a coagulum.'—Sir A. Cooper, *On the Testis*, p. 212. In a case where hydrocele was converted into hæmatocele by a blow from a hammer, Mr. Walter (*Brit. Med. Journal*, 1857, p. 524) found a rent in the tunica vaginalis, near the raphe, admitting the finger, and a ruptured artery from which the bleeding had proceeded.

‡ In the account of a specimen of this kind in Guy's Museum the patient is said to have had enlarged testicle from childhood.

Diagnosis.—When the testicle becomes quickly swollen after a blow, the swelling not being caused by inflammation, which may usually be ascertained, there is probably hæmatocele. Or if a hydrocele suddenly enlarges and loses its transparency, there is probably an effusion of blood in its cavity. The probability is, in either case, increased by the presence of ecchymosis in the scrotum. But when the affection is more chronic, and when the ecchymosis, if it have existed, has passed away and been forgotten, the diagnosis is more difficult, and must be based upon a consideration of various circumstances, such as the degree of rapidity with which the swelling took place, the distinctness of fluctuation, and the history. None of these, however, are certain guides; and the records of surgery contain numerous instances of mistake under able hands—hæmatoceles removed for malignant disease, and malignant testes opened for hæmatocele, &c. Assistance may be derived from observing carefully the rate of increase from time to time. In cancer it usually goes on steadily; but in hæmatocele it is often irregular. Sometimes the hæmatocele ceases to enlarge, or even diminishes in size; and this seldom or never takes place in cancer.

Treatment.—In ordinary cases of hæmatocele, especially when the affection is clearly attributable to a blow, the hæmorrhage ceases after a time, the inflammation excited by it subsides, and the blood becomes slowly absorbed, the process occupying perhaps a long time, and being marked by the same stages as when blood is effused in other parts. Our first efforts, therefore, in the treatment of hæmatocele are to assuage the vascular activity and the inflammatory condition by rest in the recumbent position, with the scrotum elevated; by the local abstraction of blood by means of leeches placed above the scrotum; and by cold or warm applications, according to the comfort afforded by them. After the pain has been relieved and the heat of the part reduced, the patient may move about, with a suspensory bandage, and leave it to time to effect the remainder of the cure. Even when hæmatocele supervenes upon hydrocele the same treatment should be employed; and the gradual cure of both has, in some instances, followed, without any further surgical interference.

It sometimes happens, however, from causes which we cannot quite explain, that the hæmorrhage continues; and the swelling, consequently, increases till it may contain some pounds of blood, the pain attendant upon it being proportionate to the rate at which it enlarges. The treatment mentioned in the last paragraph failing, a good-sized trocar should be introduced. If the blood is fluid, which it is sometimes found to be in these cases, great relief will often be afforded by its evacuation; and the diminution of the distension may be followed by a cessation of the hæmorrhage; so that if the swelling returns, and a second tapping is required, the fluid will be thinner and more serous than on the first occasion. Should the accumulation continue, the case may be treated with injection of iodine, as in the case of simple hydrocele. The admixture of a certain quantity of blood with the fluid evacuated does not much lessen the prospect of success from that treatment. Sometimes, however, the blood is so far solidified that the trocar is of little avail. It may then be necessary to lay open the sac freely, to turn out the clots, and wash out the cavity by means of a syringe. The wound should be left open, to prevent further hæmorrhage, and to permit an easy vent for the products of inflammation; suppuration and granulation will take place, and a cure may thus be effected. This proceeding is not unattended with danger; and, if the patient be advanced in life, it is safer to remove the entire mass with the testicle. This, however, is rarely necessary in young or middle-aged persons. One of the sources of danger is further hæmorrhage from the tunica vaginalis, which has been known to take place profusely after the cavity has been laid open; or there may be severe and extensive inflammation, followed by sloughing of the tunica vaginalis and the tissues of the scrotum, with attendant fever and constitutional depression which may prove fatal.* In some cases part of the thickened tunica vaginalis has been cut away with good result.† It has been said that when hæmatocele occurs spontaneously, it is more difficult of cure; but it is almost impossible to decide that the affection is really spontaneous, and not traumatic. Certainly the testicle ought not to be sacrificed, as would seem to have been done,‡ on the supposition that the affection was spontaneous.

The position of the testicle, under ordinary circumstances, is the same as in hydrocele; though I have observed that it varies more than it does in hydrocele. The gland, is, therefore, commonly avoided by making the incision into the fore part of the swelling. In two cases mentioned by Mr. Curling there was inversion, the testicle being situated in front; and it was cut into in each. This led to its removal in one case. It is well, therefore, before using the knife or trocar, to endeavour to ascertain the position of the gland, by tracing the vas deferens and cord downwards, and making out whether they run to the anterior or to the hinder surface of the swelling; also by information derived from the sensations of the patient when pressure is made upon various parts. Obviously it must often be impossible to assure oneself upon the point.

Encysted hæmatocele.—Pathological collections present examples of cysts, both in contact with the testicle and in the spermatic cord, which contain blood; and cases of the kind are, now and then, met with in practice. They are not easy of diagnosis, the feature by which a cyst is most surely recognised —the transparency—being absent; and they are, consequently, liable to be mistaken for solid tumours, or for herniæ. The defined round or oblong shape, the fluctuation, the connection with the cord, and the capability of being moved by traction made upon it, as in the case related at page 100, and the history, may assist in leading to a correct opinion. Mr. Curling mentions a case in which twenty-four ounces of dark grumous blood were drawn by a trocar from an encysted hæmatocele.*

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* Mr. Curling (*On the Diseases of the Testis*, p. 197) was summoned 'to a gentleman aged seventy-nine, on account of an attack of retention of urine from enlargement of the prostate gland. He had also on the left side a chronic vaginal hæmatocele, which had attained so large a size as to interfere with the introduction of the catheter. The tumour reached half-way down the thighs, and the penis was so completely buried in it that I was unable to reach the glans at the navel-like orifice in the integuments to pass the catheter. I had no alternative, therefore, but to lay open the hæmatocele, from which three pints of dark grumous blood were discharged. The thickening of the sac prevented its collapsing after the incision. The patient died a week afterwards.'

Sir B. Brodie does not recommend the negative treatment when the hæmatocele is of large size. Some artificial means should be resorted to for getting rid of it; first, because of its inconvenient bulk; and, secondly, because the pressure upon the testicle will disorganise, and in fact destroy, that organ. He found it to have been so in two cases dissected by him. *Med. Gazette*, vol. xiii. p. 380.

† Cooper's *Surgical Dictionary*, 8th ed. by Lane, art. 'Hæmatocele.'

‡ *Lancet*, 1860, vol. i. p. 191.

FIBROUS AND CARTILAGINOUS BODIES IN THE CAVITY OF THE TUNICA VAGINALIS.

At the upper end of the testicle, or about the line of junction of the testicle with the epididymis, may usually be seen a small soft fibrous body projecting into the cavity of the tunica vaginalis and covered by the serous coat of the cavity. It may be a mere granule, or it may be a polypose, membranous substance of considerable size. So far as I have seen, it is relatively as large in young subjects as in older persons; that is, it does not seem disposed to grow disproportionately to the rest of the organ, and it is doubtful whether it even keeps pace with it. It is probably connected with the mode of development of the testicle, consisting, perhaps, of some of the more or less atrophied tubes of the Wolffian body, which have not become united with the gland, or a remnant of the thread or duct which descended from the testicle in the fœtus; and it would not deserve a notice in this place were it not sometimes mistaken for a tubercle or other morbid product. Moreover, as has been before mentioned, small cysts are occasionally found in it; and these, hanging pendulous into the cavity, may be a source of irritation to the tunic. There are also sometimes developed, at or near the same spot, small solid excrescences, at first warty, afterwards leaf-like and pendulous, which, like the cysts just mentioned, may be a source of irritation and may lead to the formation of hydrocele.

Small *loose* bodies are also occasionally found in the cavity.

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* In the Sydenham Society's *Year-Book of Surgery*, 1861, p. 312, is quoted a case of hæmatocele of the tunica vaginalis, which ascended through the inguinal canal into the cavity of the abdomen. The treatment consisted in repeated tappings and injections of iodine.

They are commonly spherical, or nearly so, and are composed of laminæ of toughish fibrous, or fibro-cartilaginous, structure, with earthy matter at the middle. Their origin is involved in some obscurity in common with that of other bodies of the like kind, such as loose cartilages in joints and bursæ, phleboliths, &c. Probably they originate sometimes in the small fibrous processes just mentioned, or in cysts developed in them. These, increasing in size, becoming pedunculated, and then detached by giving way of the pedicle, and solidifying, might give rise to the bodies in question. This view derives confirmation from a case examined by Duplay:* one cartilaginous body was loose in the cavity, and another was attached by a filiform pedicle to the head of the epididymis. They are sometimes found in hydroceles.

In a patient who used to suffer excessive pain as soon as the operation of drawing off the water was over, lying down on the floor and groaning with agony for a quarter of an hour, Sir B. Brodie found a loose cartilage after death in the cavity of the tunica vaginalis.

They may be recognised during life, and removed by an incision if they are a source of annoyance. Often they do not attract attention and are discovered accidentally.

Lately, in examining the hydrocele of a man aged about fifty, which had recently been tapped, and which was rather flaccid from the fluid not having fully re-accumulated, I felt a firm smooth body slipping about in the cavity. I accordingly made a small incision, and extracted a disc as large as a bean, polished on the exterior, and composed of compact fibrous layers encircling an earthy nucleus. Hæmatocele ensued with intense pain, rendering it necessary to lay open the cavity fully. This hydrocele was of six months' duration, and had been twice tapped without there being any unusual pain or other symptom indicating the presence of a foreign body.

Other alterations in the tunica vaginalis, such as thickening and calcification, do not often occur, except in conjunction with hydrocele or hæmatocele.

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* *Archives générales de Médecine*, 1855, vol. ii. p. 133. In the Museum at Fort Pitt, Chatham, is 'a small pedunculated body of an ossific nature attached to the vaginal tunic covering the globus minor.' In pl. xiii. fig. 2 of Sir A. Cooper's work, a cartilaginous body is represented hanging from the caput epididymis by its pedicle. Sir A. Cooper has also seen one of these little bodies pendulous from the internal surface of a cyst between the tunica vaginalis and the tunica albuginea. He never detected them in the living body.

INFLAMMATION OF THE TESTICLE.

Under this head I propose to consider three affections: first, *acute inflammation;* secondly, *chronic inflammation*, including *syphilitic* disease; and thirdly, *scrofulous inflammation.* These are sufficiently distinct in their pathology, symptoms, and treatment to be discussed separately.

Acute inflammation is, comparatively, rare in the body of the testicle, but is very frequent in the epididymis. This is probably in some measure owing to the difference in the physical conditions of the two parts; the one being enclosed in a dense unyielding tunic which does not permit the phenomena of inflammation readily to take place; whereas the structure of the other is less compact and less supported by membranous investment. When the inflammation attacks the body of the testicle, the affection is called 'orchitis;' when it attacks the epididymis, it is called 'epididymitis,' though the old term 'hernia humoralis' is still often applied to it.

Acute orchitis may be caused by a blow or a wound, but is most frequently seen during the occurrence, or rather during the subsidence, of mumps. It occurs in about one in forty or fifty of the sufferers from that malady; most often in those who are about the age of puberty. It begins usually on the fifth or sixth day of the affection, commonly in one testicle, sometimes in both. The glandular part of the testicle is more often involved than the epididymis; but the inflammation may commence in either part, and extend to the other. It reaches its height in four or six days, and then gradually subsides. It very rarely proceeds to suppuration, or any other structural change, or leaves any impairment of the organ. Now and then, however, it is followed by atrophy. Neither Sir A. Cooper nor Mr. Curling have met with this in their practice. Dr. Hamilton saw it in two cases; M. Rilliet in one.*

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* Dr. Hamilton, in *Trans. of Royal Society of Edinburgh*, gives an account of epidemics of mumps in Lynn, which appear to have been very severe, in 1758 and 1761. The testicles were acutely affected in several cases, and the brain in some. M. Rilliet observed an epidemic in Geneva in 1848 and 1849.

M. Beraud (*Archives générales de Médecine*, 5^e^ série, vol. xiii. pp. 274 and 557) describes under the term 'variolous orchitis,' an inflammation of the testicle often occurring during variola. It affects occasionally the gland itself, but more frequently the tunica vaginalis and the epididymis; is attended with plastic

I was lately consulted by a gentleman who attributed the wasting of one testicle to an attack of inflammation, during mumps, when he was a boy. The organ was almost gone, the vas deferens terminating only in a small lump, which was tender.

Although both testicles are sometimes inflamed in mumps, I am not aware of any instance in which atrophy has followed in both. The possibility, however, of this sequence in both organs, and its occasional occurrence in one, should induce us not to neglect the ordinary means of mitigating the inflammation when it supervenes, such as rest, cooling lotions, and saline aperients. It is not necessary, or wise, to resort to more active measures, unless the inflammation be very severe. Orchitis is also an occasional attendant on rheumatism.

I do not remember to have seen a case of simple acute orchitis—that is, an acute inflammation of the substance of the gland—unless it were caused by a blow, or associated with mumps or some urethral irritation. Nor do I meet with a clear description of it in surgical writings. Still it is most probable that it does sometimes happen.

In the Museum of St. George's Hospital is an example of 'purulent deposits in the testicle in combination with synovitis:' but this was in a case of pyæmia. Mr. Ludlow has recorded a case, under the care of Mr. Stanley, in which acute inflammation of the body of the testicle in a feeble person (a sufferer from stricture), went on to suppuration and gangrene of a portion of the glandular substance.*

In infants.—Mr. Curling mentions some cases of inflammation attacking the testis of young infants. The symptoms were acute, and the swelling was considerable; but the disease soon subsided, and was always confined to one testis. I have seen similar cases. The testis was very hard, and I judged that the inflammation was seated in the body of the gland. I could not discover any especial cause for the affection.

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deposit in the latter, and with the effusion of serum and fibrinous matter into the cavity of the tunica vaginalis.

'Epidemic catarrhal orchitis.' In a recent epidemic of catarrhal fever described by M. Desbarreaux-Bernard, of Toulouse, to which the prevalence of mumps imparted a special character, the inflammation of the testis appeared at once in several patients without any preliminary affection of the parotid whatever.—*Med. Times and Gaz.* vol. xix. p. 512.

* See cases of partial gangrene of the testis, *Med. Times and Gazette*, vol. x. p. 338; vol. xiii. pp. 568 and 631.

Mr. Paget has 'a specimen in which extensive deposits of lymph and pus are seen in the testicle of a man in whose urethra a portion of calculus was impacted after lithotrity.'

Epididymitis.—The exciting causes of epididymitis are injuries to the organ from pressure, blows, &c., and some irritation in the urethra, more particularly in the part of the urethra contiguous to the orifices of the seminal ducts. Thus the affection sometimes follows lithotomy; the impaction in, or the passage of calculi through, the urethra; stricture of the urethra, or the introduction of instruments for the relief of stricture or for other causes; and, above all, the inflammation of the urethra attendant upon gonorrhœa. It may also occur spontaneously in persons of rheumatic or gouty diathesis, and in other persons.

In the acute stage of gonorrhœa pains are often felt in the testicle, accompanied by soreness; but these seldom are the immediate precursors of anything further. They subside as the severity of the urethral affection abates; and the inflammation of the testicle does not commonly supervene till a later stage, when, perhaps, discharge is the only remaining symptom of the gonorrhœa. It may be induced, then, by slight causes, such as much exercise, especially on horseback, or by tight trousers. So long as the discharge lingers, so long is the patient liable to swelled testicle; and those measures are most preventive of the latter affection which most quickly put an end to the former. The sudden suppression of urethral discharge may, now and then, by a sort of metastasis, induce inflammation of the testicle; but this is so rare an event that the apprehension of it need not influence our treatment of gonorrhœa. It has been supposed to be more common than it really is, because the onset of the inflammation in the testicle is generally, though by no means always, attended with a diminution of the discharge from the urethra; and cause and effect have been often confounded. That the affection of the testicle is rather the cause than the effect of the subsidence of the urethral inflammation is proved by the fact that it is very commonly excited by some injury; and, moreover, when it subsides, the urethral affection usually reappears. There is no evidence, in the greater number of cases, that the inflammation travels along the vas deferens from the urethra to the testicle. I do not know that we can offer any other explanation of its occurrence than is conveyed by the term 'sympathetic.'

The course and symptoms of the inflammation are much the same whether it accompany gonorrhœa or other irritation of the urethra, or be excited by some other cause. The epididymis is the part first and chiefly affected. Attention is attracted to the malady by pain which, after a time, is felt not only in the scrotum but in the groin, the iliac region, and in the loins. The testicle is tender; one end, usually the lower, of the epididymis is enlarged and very tender; and the vas deferens may also be thickened and tender. The whole of the epididymis soon becomes involved, serum and lymph being infiltrated in the cellular tissue between the convolutions of its tubes, so as to form an elongated mass at the back of the testicle; and the swelling is much increased by the effusion of fluid mixed with lymph into the cavity of the tunica vaginalis * and into the loose tissue of the scrotum. The skin also is inflamed. The pain is often very severe—especially in the early stages—dull, heavy, sickening. The bowels are generally constipated, and the patient is feverish and sick. The constipation and sickness have, in some cases, been so obstinate as to cause apprehension of hernia. The inflammation rarely proceeds to disorganisation of the tissue, or even to suppuration. It generally subsides in a few days, leaving fluid and lymph in the tunica vaginalis and the epididymis enlarged and hardened. These remnants gradually disappear, and the organ resumes its natural size; and its function is in great measure restored, though this, for obvious reasons, is not easily ascertained with certainty. Such at least is the usual course, even when not modified by treatment. I have seen many cases which have been left without treatment, or even rest; but I do not remember any, where the inflammation was of a simple kind and in a healthy subject, which did not terminate in resolution, or any in which atrophy of the organ was clearly traceable to this cause.

Sometimes when the inflammation has continued for a long time, the tubes become thickened and dilated, just as we find in the case of the ducts of the kidney and other organs when they have been the subject of chronic inflammation. These changes

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* The extension of inflammation from the epididymis to the tunica vaginalis, and *vice versâ*, takes place more readily than from the testicle, because the areolar tissue of the epididymis, which tissue is usually attacked by the inflammation, is in close contact with the tunica vaginalis—indeed is continuous with the attached strata of that tunic; whereas the areolar tissue of the testis is enclosed by the thick fibrous tunica albuginea, which separates it from the tunica vaginalis, and acts as a barrier against the passage of inflammation to and fro. The fluid in the cavity of the tunica vaginalis sometimes amounts to several ounces in these cases.

are dependent partly upon the direct effects of the inflammation, and partly upon distension from the secretion not finding a ready passage. They are not necessarily persistent; for, if the inflammation subsides, the tubes may gradually resume nearly, or entirely, their natural calibre. Occasionally the dilatation of the tubes is caused by seminal engorgement, consequent on obstruction or obliteration of some of them, as described by M. Gosselin.*

I have said that the epididymis is the part first and chiefly affected; but if the inflammation be very severe or long continued, it is liable to extend to the body of the testicle. At least such is the opinion of several pathologists;† and it is probable that it does so. It is certain, however, that it rarely proceeds to any great extent there, or causes much alteration in the tissue.

Treatment.—It is not usually necessary to adopt any severe plan of treatment. Now and then the disease may be arrested in its initiatory stage (that is, when the inflammation is commencing in one part of the epididymis) by well-adjusted pressure with plaster and bandage, or by antimony freely given, or by pressure and antimony combined: but the pressure often cannot be borne; and antimony, in large doses, though it sometimes causes a marked alleviation of the symptoms, not unfrequently tells more upon the patient than upon the malady. Leeches, especially if they be placed upon the scrotum, certainly increase the external swelling and inflammation; and their beneficial effect upon the testicle is often questionable. If they be placed above the scrotum, in the course of the cord, they do as much good and are productive of less annoyance. I have never tried the plan of opening the veins in the scrotum. Rest in the recumbent position; mercurial and saline aperients; antimony, given so as to produce and maintain nausea, and combined with small doses of mercury; with a spirit-lotion applied upon a soft folded rag, beneath a handkerchief so arranged as to support the part, and prevent it hanging between the thighs and to keep it moist, seem to moderate the severity of the malady as much as sharper measures, and do little or no harm to the patient. It is very rarely advisable to give opium, and seldom necessary to affect the system decidedly with mercury. Mr. Watson* has found relief afforded by the plan, proposed by Vidal de Cassis, of puncturing the testicle during the acute stage. The relief was greatest when fluid was evacuated by the puncture from the tunica vaginalis. If the induration and enlargement of the epididymis linger more than usual, they may be reduced by pressure with plaster and bandage, or by iodine and mercurial ointment combined and rubbed upon the scrotum so as to produce slight irritation of the skin. It is important to secure the restoration of the part to a natural condition as soon as possible; forasmuch as the observations of MM. Gosselin † and Godart indicate that a thickened indurated state of the upper or lower end of the epididymis often prevents the passage of the secretion of the testicle to the vas deferens; and that so long as it remains, though there may be all the signs of virility, with desire and power of copulation and emission, there is likely to be no impregnation, in consequence of the absence of spermatozoa in the fluid emitted.‡ If the fluid in the tunica vaginalis remains,

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* *Archives générales de Médecine*, 4^{e} série, vol. xiv. p. 405, vol. xv. p. 40. This author made several dissections where the tubes of the epididymis or the vas deferens were impermeable and transformed into fibrous or other structure; and it is worthy of remark that in none of them was there any atrophy of the substance of the testis. In some the tubes below the obstruction were dilated; in some, they retained their natural size. The vesiculæ seminales were of natural size in all the instances in which they were examined. The cause which led to the obstruction, whether it were inflammation or not, was uncertain in each of the cases; but we learn from these observations that the absence of atrophy after an inflammatory attack is not certain evidence that the function of the organ is capable of being performed; which is in accordance with the observations and experiments at p. 73. Mr. Curling says that in only two cases where the epididymis had suffered from inflammation had he remarked a decidedly atrophied condition of the organ. He speaks of suppuration occasionally taking place.

† Velpeau, in *Dict. de Méd.*; Demme, in *Virchow's Archiv,* vol. xxii. p. 177; a writer in *Brit. and For. Med. Rev.* vol. xvii. p. 76.

In the *Edinb. Med. Journ.* vol vi. p. 455, is a case of acute suppuration and hernia testis supervening upon gonorrhœa.

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* *Med. Times and Gazette*, vol. xxxii. 520, and vol. xxxiv. 390.

† *Archives générales de Médecine*, 5^{e} série, vol. ii. p. 257.

‡ See obs. confirmatory of that view by Mr. Curling, *Brit. and For. Med.-Ch. Rev.*, April 1864.

M. Liégeois (*Med. Times and Gazette*, Sept. 25, 1869, p. 381) has examined 28 cases of bilateral epididymitis at various periods after the attack, and found spermatozoa in only seven; of these the affection in five was from accidental causes, *i.e.* not from gonorrhœa. And he accordingly makes a distinction in this respect between the *external* epididymitis and the blenorrhagic or *internal* (that is, commencing in the interior of the tube), believing that the latter is much more likely to interfere with the passage of the semen. 'These numbers speak for themselves; they will suggest to every one the importance of the antiphloafter the induration and swelling of the epididymis are gone, it may be treated as a case of ordinary hydrocele.

Sometimes the affection is prolonged, or recurrences of inflammation are induced, by the presence of a stricture or other source of irritation in the urethra; and when this is removed, the testicle usually soon regains its natural state under appropriate management. In the treatment of obstinate or recurrent epididymitis it is, therefore, well to examine the condition of the urethra by passing a bougie. Such cases should not be neglected, because, as just pointed out, the tubes of the part are liable to be impaired or destroyed by the effusion of lymph and other effects of protracted inflammation.

Chronic inflammation, including syphilitic disease.—Chronic inflammation of the testicle is seldom a relic of acute inflammation. It may be due to stricture of the urethra, or to injury; but the most common cause is syphilis; and the following account is drawn chiefly from the observation of that form of the disease. It usually occurs in what is called the tertiary stage of syphilis; the most frequent concomitant symptoms being inflammation of the bones and ulceration of the skin and throat; or it may occur alone, without any other secondary or tertiary symptoms; or it may commence after these have subsided. It is most frequent in those who are pale and feeble.

The inflammation is often insidious, and may at first be unattended with pain and confined to a part of the organ. The patient, perhaps, accidentally discovers that one or both of his testicles are enlarged and hard, or that some part of one or both is in this condition; and he may not be aware of the presence of any such disease till it has made considerable advance. The surgeon should, therefore, examine the organs in suspicious cases; indeed, in all cases of tertiary syphilis it is well to do so. Occasionally it is met with as a congenital affection in infants.*

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gistic treatment, the necessity of calming the inflammatory element, on the intensity of which seems to depend the danger of definitely obliterating the excretory duct of the seminal fluid.' All the other elements may be present without the spermatozoa, showing that they are furnished by the seminal vesicles or prostate. M. Liégeois even affirms that in unilateral epididymitis the secretion of the opposite testicle is diminished at the time and long afterwards (*loc. cit.* p. 513 and 541), thus indicating a difference between the testicles and other double organs 'which mutually support themselves, and redouble their energy when the function of one of the two is impaired.'

* *Path. Trans.* vol. xvi. 189.

Pathology.—The structure chiefly affected is the areolar and septal tissue of the gland, as well as the tunica albuginea, and the mediastinum; and less frequently the areolar tissue of the epididymis. These tissues become indurated by the deposition of lymph into their substance, causing enlargement, hardness, and heaviness of the organ; and the deposit often takes place irregularly, affecting some of the lobules and not others, or affecting them unequally.

The knotty outline of the testicle, which, when present, is very characteristic of this disease, depends also partly, and in some instances entirely, upon another cause besides the unequal manner in which the lobes are affected, and that is, upon a deposit of lymph, or plastic material, in nodules or tubercles, in or upon the tunica albuginea, or in the areolar tissue of the testis. These nodules are sometimes very dense; they have commonly a whitish or faint yellowish-white colour, and are sparingly streaked with blood-vessels, which exist in greater numbers at their circumference; and they are described, by those who have examined them microscopically, to consist chiefly of fine nucleated fibres, and to show a tendency to oily degeneration towards the centre.*

If the disease subsides in an early stage, the lymph may be nearly or quite absorbed, leaving the tissue little impaired. If the lymph be more abundant, or be more organised, it is likely to remain, causing thickening and opacity of the septa and gradual contraction of them; and this contraction, as in cirrhosis of the liver, is attended with shrinking and wasting of the glandular substance. In this way, atrophy of the testicle, more or less complete, may be brought about. The disease in that stage is well illustrated by specimens (2351, $^{56, 57, 58}$) in Guy's Hospital Museum, which are described as examples of 'fibroid degeneration of the testicle,' and are attributed to syphilis. In these specimens the glandular tissue is seen to have in great measure disappeared, being replaced by opaque white fibrous tissue, diffused and in nodules, which bears all the appearance of having been the product of inflammation. Both testicles are affected in a nearly equal degree in each of the three cases. The intermediate or remaining glandular parts appear to be sound, also the vas deferens and the epididymis.

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* Virchow, in his *Archiv*, vol. xv. p. 263; and Demme, in *Virchow's Archiv*, vol. xxii. p. 181.

Sometimes, however, perhaps usually when the disease is long continued, the inflammation extends to the tubules, the walls of which become thickened and blended with the intervening tissue, according to Virchow,* while the epithelium lining them undergoes pigmental and fatty degeneration.†

Not long ago, examining a patient who died from other causes, I found both testes of about the natural size, hard and knotty, with the glandular structure almost obliterated, its place being occupied by a mass of firm indurated tissue like old organised lymph, except at one point where the natural structure appeared quite sound. There was no history in this case, but it was probably one of syphilitic disease. In some cases the gland-tissue is so entirely supplanted by fibroid tissue, and the symptoms that have attended the change have been so slight, as to suggest that it was a result, not of orchitis, but rather of a degeneration.‡

M. Vidal (de Cassis)§ lays great stress on the tendency to atrophy of the syphilitic testis. He gives, however, instances of the recovery of function in testicles which had been severely invaded by syphilitic inflammation.

A testicle which has been hard and knotty from chronic inflammation may remain in that state for years, undergoing very little change and being a source of little or no inconvenience. It may even, to some extent, perform its function. Under such circumstances the patient is not usually willing to submit to treatment; and if it be clear that the disease is not progressing, it is scarcely worth while to interfere; for the effused lymph, which is the cause of the hardness, has probably acquired such consistency that it will not become absorbed, except under the influence of means which may injure the health or do damage to the remaining tissue of the organ.

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* *Archiv*, vol. xv. p. 264.

† 'The coni vasculosi become thickened, hardened, and of a dark-brown colour.' 'In general there are marks of inflammation upon the tunics of the testis, such as, for example, adhesion; the substance of the gland itself is changed, the septa are much more apparent than natural, the seminiferous tubes appear to be less in number, are undoubtedly much reduced in their size, and many become cords instead of tubes.' 'The absorption may proceed till the whole of the glandular structure of the organ is removed, leaving the tunica vaginalis adherent to the tunica albuginea and the septa within the latter; but the whole substance which remains is not larger than the extremity of the finger, and it feels a firm and very solid body.'—Sir A. Cooper, *On the Testicle*, pp. 23, 24.

‡ Dr. Wilks, at Path. Society, *Lancet*, 1859, vol. i. p. 538.

§ *Mém. de la Société de Chirurgie de Paris*, vol. ii. p. 92.

The disease is sometimes, though not very often, accompanied by effusion of fluid into the cavity of the tunica vaginalis. When it is so, we cannot judge of the condition of the testicle till the fluid has been evacuated.

By most authors this disease—'syphilitic sarcocele,' as it is sometimes called—is not sufficiently distinguished from the scrofulous disease—scrofulous or 'tuberculous sarcocele'—to be presently described. Yet there are very considerable and important differences between the two in their causes, their nature, and their treatment, as well as in the tissues primarily affected by them. The chronic inflammatory disease does not often originate spontaneously, but is due to a blow, to a source of irritation in the urethra, or to syphilis; whereas the scrofulous disease is not usually traceable to these causes, but is dependent upon the scrofulous diathesis. The morbid product, in the one instance, is situated primarily and commonly in the connective tissue, and has a tendency to fibrous development; in the other it exists primarily and chiefly in the tubules, though tubercles are sometimes developed in the connective tissue, and it has more the molecular or cell form, with tendency to oily, or caseous, or earthy, or more frequently purulent degeneration. The one disease may require antiphlogistic treatment, and yields more readily to mercury and iodide of potassium than to any other means; the other is rarely benefited by depletion or mercury, but requires measures directed to promote the general health. Both, however, are liable to suppuration and the subsequent protrusion of the glandular substance in the form of 'hernia testis;' and this has probably led to the two diseases being confounded together.

Suppuration.—The inflammation sometimes goes on to suppuration, the pus being formed in the substance of the testis, and being, consequently, bound in by the tunica albuginea. Supposing it to be formed only at one or two points and in small quantity, it may remain for a great length of time in the testicle; and becoming surrounded by a thick wall of lymph, it may dry up into a caseous or putty-like substance, or be the seat of calcareous infiltration, and so be ultimately converted into an earthy mass. Small abscesses in these stages of decline are not unfrequently met with in the testicle, and occasionally are symmetrical in the two testicles. They are commonly thought to be of tuberculous origin, and probably are so sometimes. It now and then happens that a small collection of pus pent up in the testicle is a source of a good deal of irritation, and gives rise to frequently recurring attacks of inflammation. In the Museum of the College of Surgeons is a testicle with a small abscess in the epididymis; it was extirpated because it had for many years been the seat of the most severe pain.

When once matter is formed, however, it generally increases, as in the case of abscesses in other parts, and distends the tunica albuginea and other tissues of the testicle. It thus induces absorption, to a greater or less extent, of the glandular tissue, and gradually makes its way through the tunica albuginea, most commonly through the fore part. The tunica vaginalis becomes adherent ; so do the superficial structures, and the matter is in course of time discharged through them. The aperture may continue for a time, and then close, the disease abating ; or a succession of abscesses may form, burst, and heal.

Hernia testis.—Sometimes, however, healing does not take place so favourably. The aperture in the skin is enlarged by ulceration, and discloses a firm coarsely granular mass connected with the testicle. The mass might be supposed, even when removed from the body, to be formed by granulations sprouting from the anterior surface of the testicle : a section, however, almost always shows that it is composed, as first pointed out by Sir W. Lawrence,* of the indurated and altered structure of the testicle, pressed through the ulcerated opening in the tunica vaginalis, constricted where it is girt by the tunic, and expanding and granulating beyond it. It is seldom large, and the testicle has usually become much reduced in size when the protrusion takes place ; so that altogether the protruding mass and the remnant of testicle often do not more than equal the natural size of the organ. The amount of the protrusion varies from a small nodule to the whole substance of the testicle. In some cases the entire glandular part of the testicle, and with it the mediastinum, is projected through the tunica albuginea, and stands out beyond the level of the skin ; and even then, as just said, the protruding mass is not very large.

The integuments around the hernial protrusion are usually indurated, and more or less undermined. Sometimes they constrict its neck like a collar. Sometimes they are ulcerated as well as indurated, the ulcers spreading with everted edges and very painful, so that the disease presents many of the characters of cancer. In a case lately under my care the affection was thought to be malignant, and had much that appearance; but under mercurial inunction the protruding mass shrank and the ulcers healed.

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* *Edinb. Med. and Surg. Journal,* vol. iv. p. 257.

In this disease, whether the epididymis be implicated or not, the vas deferens is not usually diseased. In all the cases that I have examined, though some were of long standing and far advanced, that tube retained nearly or quite its natural size, and so far as I could judge, its natural condition. Nevertheless M. Liégeois finds that the seminal fluid is usually deprived of spermatozoa when the affection is double; but they may re-appear, and often do so under the influence of iodine.*

Diagnosis.—The pain attendant on chronic inflammation of the testicle varies with the rate at which the disease progresses. When this is slow, there is often no pain at all, or merely an uneasiness which may not be constant. Indeed, as before said, the patient may be first apprised of the malady by finding one or both testicles larger than natural. When the testicle swells more quickly, the pain is often severe, dull, heavy, aching, extending to the loins. Sometimes it is perceived only in the loins. When matter is forming there is usually pain; though this also depends upon whether it forms quickly or not. The enlargement of the testicle from chronic inflammation may be distinguished from that dependent on other causes by its appearing first in the body of the testicle, and by the uneven, knotty feel, or stony hardness of the gland. The part is usually tender, and more or less painful. It rarely attains to any great size. The distinction between testicle and epididymis is soon lost; perhaps the latter becomes involved in the disease; and too frequently, both testicles are affected, the disease probably showing itself at corresponding parts of the two organs. The presence or history of syphilitic disease in other parts of the body will further assist in the diagnosis. If there be hydrocele superadded, it may be impossible to recognise the condition of the testicle till the fluid has been evacuated.

Treatment.—The greater tendency of chronic inflammation, as compared with the acute form of the disorder, to show itself in both testicles and to impair or destroy the glandular tissue of the organs, renders its treatment very important. It is also a more complicated and difficult matter than the treatment of acute inflammation of the testicle; for not only is chronic inflammation, under most circumstances, a more obstinate and less amenable affection than the acute, but in this case it is, in addition, often associated with, and dependent upon, a constitutional malady which requires very much patience and good management for its control. The local treatment is such as is suited to chronic inflammation of other parts:—rest, and support by means of a suspensory bandage, with perhaps the more decided pressure of an elastic bandage or of plaster. Well-adjusted pressure is an effective means of reducing the size of a testicle enlarged by inflammation. It is not of much service—indeed, it usually cannot be borne—when suppuration has commenced. Hydrocele, in addition to the enlargement, facilitates the employment of pressure; and I have remarked, that the fluid does not so easily disappear under its influence as does the more solid swelling of the testicle. The pressure may be alternated or combined with the application of iodine and mercurial ointment; or the latter may be employed alone, for a great number of cases of chronic enlargement of the testicle will be found to yield to its influence. Leeches are sometimes of service. The best plan is to apply a few, three or four, upon the scrotum—the objections to placing them on the scrotum, mentioned when speaking of acute inflammation, not holding good in the case of chronic inflammation; and they may be repeated two or three times a-week.

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* *Med. Times and Gazette,* Nov. 6, 1869, p. 541.

Attention to the general health forms a most important item in the treatment of most chronic inflammatory affections; but the directions must be regulated according to circumstances; and I simply allude to it here for the purpose of indicating that it must not be forgotten.

When suppuration has taken place the abscess should be opened early; and the opening should be maintained so as to insure a free vent for the matter. If a sinus remains long, after either the artificial or the natural opening of the abscess, it may be laid open and cauterised to the bottom. When the granular substance of the organ protrudes, forming what is called 'hernia testis,' a cure may often be effected by pressure with plaster carefully and perseveringly applied. The plaster should be renewed at least once daily, in some instances twice a-day. It is well to leave an hour or two between the removal and the re-application of the plaster, during which time the surface can be well cleansed and refreshed. Some lint or charpie, with nitric oxide of mercury, or some stimulating fluid, may be placed upon the granulating mass beneath the plaster. If this plan fails, or is likely to fail, the protruding part may be removed with the knife or caustic; or, which is a better plan, the undermined skin may be divided, and all sinuses freely laid open, even if they extend into the substance of the testicle. The edges of the skin should then be pared away; and the skin having been separated from the testicle on either side, its edges are to be united in front of the testicle by suture, as suggested by Professor Syme. It may be desirable to remove the protruding part before approximating the edges of the skin, as practised by Sir A. Cooper: this, however, is not often necessary; for the granular mass, when it is covered by the skin, sometimes shrinks, and gives no further trouble. If the union of the skin fails, and suppuration takes place beneath it, and the granular mass reappears, a cure is still not necessarily to be despaired of; and it may be promoted by attention to the general health, and by stimulating applications or pressure. I have also heard of an operation performed in Glasgow, and devised by Dr. Pagan of that city, which consists in dissecting down methodically to the tunica albuginea, and then incising the margin of the aperture in that tunic like the ring in a strangulated hernia. After this the treatment of the affection is said to be much more successful. We should be unwilling to remove the organ, because, even in the very worst cases, a sufficient amount of glandular structure sometimes remains so far unimpaired as to perform its function or to admit of being restored for that purpose. It may, however, be desirable to resort to this measure if one testicle only is involved, when the disease in it has been extensive, and when the state of the patient's health requires a speedy relief from the local source of irritation.

When the chronic inflammation of the testicle is part of a syphilitic affection, which is very often the case, the treatment must be conducted in accordance with the principles laid down in the essay on SYPHILIS. I will only here remark that the plan which I have found most effectual, indeed rarely to fail, in chronic orchitis, whether there be a syphilitic history or not, if commenced before suppuration has taken place, is the rubbing in of mercurial ointment. A small quantity is to be rubbed into the scrotum, or any other part of the body, once or twice a day. It is scarcely necessary to carry the mercurial influence upon the system to such an extent as to affect the gums. Small doses of the iodide of potassium may be given at the same time; and the decoction of sarsaparilla, made fresh and taken to the amount of a pint or a pint and a half daily, is very beneficial when the patient is debilitated. In this and other syphilitic affections the mercurial infrication has, so far as my observation goes, proved more effectual than the fumigation or bath; and, with a little care in varying the place of its application, the irritation of the skin liable to follow its use may be avoided. Even when suppuration has taken place, the mercurial influence may be beneficial in promoting the removal of the effused lymph, and, occasionally, in determining the absorption of the pus.

In syphilitic cases I have known the ulcers of the skin, consequent on the bursting of abscess formed in the testicle, and accompanying the hernial protrusion, to spread quickly with foul surface and sinuous edge, and to be attended with great pain. Under the use of opium, combined with other measures for supporting the skin, so as to relieve it of the pressure of the testicle, and for reducing the size of the testicle, this serious aggravation of the malady may be overcome.

Those measures which most tend to arrest the disease, and promote the removal of the effused lymph, are the most calculated to prevent the atrophy which is liable to ensue upon chronic inflammation of the glandular structure of the testis. The atrophy may commence during the swollen state of the organ; indeed, atrophy and enlargement may go on together. We do not, however, obtain evidence of the former till the swelling subsides. We then find that the diminution does not stop when the organ is reduced to its normal size, but continues, and may go on till the testicle almost entirely disappears. I do not know that any means can be adopted which give much hope of staying the progress of atrophy. An invigorating plan should be pursued—fresh air, cold ablutions, nutritious diet, &c.

A recurrence of the disease—and this has been found to take place in several instances—is best prevented by continuing the mercurial influence, in a slight degree, for some time after the testicle has resumed its natural state. This treatment should be combined with a general tonic regimen and measures decoction of sarsaparilla certainly has a beneficial effect in these cases.

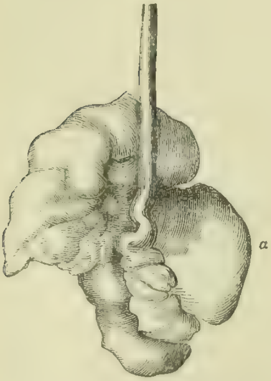
I have thought it best to consider syphilitic orchitis in conjunction with common chronic orchitis, because the two affections correspond closely in nearly every particular. The symptoms and course of the two are the same. Their pathology, so far as we can judge from external examination, is the same. There is the hard knotty enlargement, commencing usually in the body of the testicle, but affecting often the epididymis; there is the tendency to suppuration, to hernia testis, and to atrophy. And this view of the pathological relationship is confirmed by the few opportunities which have been afforded of examining syphilitic testes in the early stage of the disease. The treatment is the same; the only difference being that where a syphilitic virus is present, the tendency to recurrence of the disease is greater, and the remedies must, consequently, be more perseveringly continued. Lastly, and this is not the least important reason, the two affections can be distinguished only by the history, or by the presence or absence of other symptoms; and it is probable, if not certain, that many—I would say most—of the cases supposed to be examples of simple orchitis are, in reality, the result of syphilitic disease.

Chronic orchitis is sometimes met with in one or both testicles in infants, the part being enlarged and hard, and perhaps tender. In some cases it has been attributable to syphilis; and it generally yields to mild mercurial treatment.

Scrofulous or tuberculous disease is one of the most common affections of the testicle—more common than is generally supposed. It is most frequent in young men; but is sometimes met with in children and in aged persons. It is often associated with phthisis, and may be found in the examination of many of the victims of that disorder, in whom there has been no suspicion of its existence during life. Ordinary inflammation—acute and chronic—has just been described as displaying itself, chiefly and primarily, in the intertubular areolar tissue and in the fibrous septa of the testicle and epididymis. Scrofula, on the contrary, is very much a disease of the tubular structure, the areolar and fibrous tissues being involved, in most cases, only secondarily, in consequence of the inflammation which ensues, or by the development of tubercles in them; and often they escape till a late period. It attacks both the testicle and the epididymis, though not appearing in quite the same form in both, or at quite the same time.

Affecting the epididymis.—As a general rule, to which there are many exceptions, it appears earlier, and progresses more quickly, in the epididymis. The convoluted tubes of the epididymis become swollen and distended with white scrofulous matter, which is at first contained within the tubes, blended with the epithelium, and is made up probably, in part at least, of accumulated and morbid scales of epithelium. In this condition the epididymis is enlarged in part, or usually in its whole length, to the thickness, perhaps, of one's finger; and, thus swollen, may be felt embracing the hinder, upper, and lower parts of the testicle. It is smooth on the surface; and the unaltered areolar tissue may be dissected from it, so as to disclose the tubular structure, which is still quite apparent, and which may be, to a greater or less extent, unravelled. The disease extends, commonly, for some distance up the vas deferens; and that tube becomes enlarged to two or three times its natural size, and is filled with yellowish-white scrofulous matter. Soon the mucous and other tissues of the tubes of the epididymis become infiltrated with, or degenerated into, the scrofulous substance, and gradually disappear, so that the coils of the tubes are blended and lost; and the epididymis is thus, more and more, converted into a mere bag of scrofulous matter. At the same time that matter softens; and, when the softening takes place, the surrounding areolar tissue inflames, and is infiltrated with serum and lymph, preventing the free movement of the skin upon the part. As the softening progresses to suppuration, the epididymis becomes distended and fluctuating, presenting the condition of a scrofulous abscess; the skin becomes more adherent and inflamed, the intervening tissues are removed by absorption, and, the abcess bursting or being opened, the ordinary turbid scrofulous pus is discharged. The opening does not soon close, but continues for a long time—for months or years—to give vent to a thin watery fluid, and now and then to portions of earthy matter; and a narrow channel, with thick walls, feeling

FIG. 326.

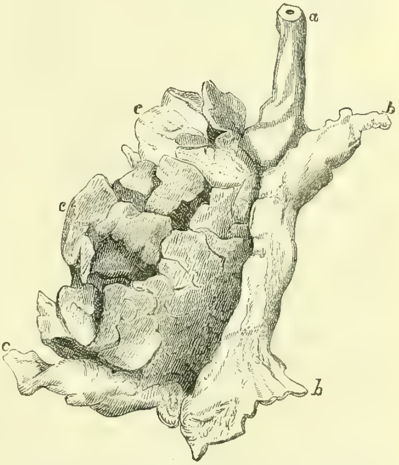


Scrofulous disease of the epididymis: *a*, body of the testicle unaltered.

like a cord, may be traced from the skin to the diseased part of the epididymis. Commonly other abscesses form in a similar manner, and either burst through the same opening or give rise to other sinuses.

Affecting the body of the testis.—While these changes are going on in the epididymis, the disease makes its way into the rete and body of the testicle; unless, indeed, it has previously commenced in those parts. The rete becomes enlarged and consolidated; and its structure appears to undergo the same changes as that of the epididymis. In the body of the testicle the disease shows itself, at first, in a less uniform manner than in the epididymis. It appears in the form of small grey tubercles—very like the grey tubercles of the lungs—sparingly scattered through the tubular structure.* They do not, however, appear to resemble the pulmonary tubercles in softening down into separate vomicæ; but they

Fig. 327.



Scrofulous testis: *a*, thickened vas deferens; *b*, *b*, suppurated, ragged, partially destroyed epididymis; *c*, *c*, *c*, greatly enlarged and diseased lobes of the testis exposed by reflection of the tunica albuginea. They have been easily separated, the intervening tissue being soft and healthy.

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* 'The small isolated yellowish-grey bodies found in the testicle in the early stage of the disease are composed of coils of diseased seminal tubes with altered contents.' 'The contents consist mainly of large cells, some of which exhibit vesicular nuclei and are disintegrating; of smaller shrivelled cells, or irregularly-shaped nuclear particles, and of a small quantity of granulo-molecular matter. The distension of the tubules in some places is sudden and globular, so that the distended portion, with its contents, forms a small tumour.' 'The matter accumulates until the tubes burst, and their contents are extravasated among the surrounding tissues.' 'With further disintegration more molecular matter and fat are developed, and at last earthy salts.'—Dr. Andrew Clark, in Curling *On the Testicle*, p. 282, and *Trans. of Path. Soc.* vol. vi. p. 91. In vol. ix. Dr. Clark adds, that the 'deposit has a different structure at different periods of its growth, and at different parts of the same deposit. Thus, in the centre of a large deposit the structure is chiefly granular, at the circumference chiefly cellular.' In one specimen he found numerous fine crystals of the triple phosphate between those tubes in which the deposit was being produced. The relation of these crystals to the pathological process he has not determined. See drawing by Cruveilhier, *Anatomie pathologique*, livraison 9^e, Pl. I. fig. 2.

enlarge and become confluent, and so occupy and consolidate considerable portions—it may be the whole—of the glandular structure, the intervening tissue remaining unaffected. Thus we occasionally find the lobes of the testicle more or less swollen from infiltration of yellowish-white scrofulous matter, yet distinct from each other, and separated by the areolar tissue and the fibrous septa, which still retain their natural characters. In other cases the areolar tissue becomes thickened, coarse and indurated, as in ordinary chronic inflammation; or it may be absorbed, the lobes, as well as the tubes, being thus rendered confluent into one opaque, yellowish-white, cheesy substance, which fills up the whole space enclosed by the tunica albuginea. Soon softening commences, usually at the middle of a lobe; and an abscess is formed, which makes its way through the tunica albuginea and the superficial structures, just in the same manner as does the ordinary chronic abscess. As in that case, a protrusion of the altered substance of the testicle—'a hernia testis'—may follow, forming a coarsely granulated mass, covered, perhaps, wholly or in part, by soft white detritus of tissue, and presenting through the ulcerated opening in the skin. The changes that have been described may go on, *pari passu*, in the testis and in the epididymis; so that the glandular substance may be disorganised, and may present at the fore part of the scrotum, while the epididymis is converted into abscesses bursting through the hinder part and sides. I have also seen the swollen but unbroken body of the testicle, simulating 'hernia testis,' protruded through the skin which was ulcerated and undermined in consequence of the formation, spreading, and bursting of abscesses from the epididymis. More commonly, however, the disease in the one part of the organ progresses more rapidly than in the other; and we find, accordingly, that when the epididymis has suppurated, there are often only a few tubercles in the testis, and when the latter is infiltrated or softened, the epididymis may be merely altered in shape, spread out upon, and, so far as external appearance goes, blended with the testis.

Tubercles.—Associated with this scrofulous affection of the lining membrane and epithelium of these tubules there may be found genuine tubercles—the 'miliary tubercles' of Laennec, the 'granular or knotty tubercles' of Virchow—occupying the delicate connective tissue between the tubules. They sometimes exist alone, or precede the disease of the tubules. They enlarge by formation or proliferation of cells on their exterior, and become aggregated into larger masses, between which the tubules are compressed and destroyed; so that, in time, the affected lobules are converted entirely into tuberculous matter. Or, more commonly, the tubules are diseased at the same time, so that their walls are destroyed, and the scrofulous matter in their interior is rendered confluent with the tuberculous matter on their exterior, forming a homogeneous mass, which undergoes the changes just described. These tubercles are found, most frequently, in the hinder part of the lobes of the testis, near to the mediastinum, and are regarded as indications of a more depraved constitutional diathesis than the scrofulous affection of the tubules. It is, however, impossible to distinguish during life between the two; and, even when the part has been removed from the body, it is not easy to decide whether the small spherical white bodies, commonly recognised as tubercles, are the genuine tubercles of the areolar tissue, or are the result of a degeneration of the tubular structure. Neither is the distinction of much practical or pathological importance. Probably it is the same disease in both instances, the difference consisting simply in the tissue in which it is seated.*

Scrofulous disease often affects both testes, though it is commonly more advanced in one than in the other. It is liable to extend along the whole length of the vas deferens, and to involve the vesiculæ seminales and the prostate gland, leading to changes in them corresponding with those in the testicle. I have also seen cases in which the disease was not confined to the genital tubes, but affected those of the urinary system also, causing dilatation of the ureters, pelvis, and calices of the kidneys, with thickening and degeneration of the lining membrane and epithelium, so that the swollen tubes were almost choked up with the scrofulous matter, while the cortical substance of the kidneys was streaked and spotted with yellowish-white deposit, or riddled with abscesses.

Reparative processes.—To what extent reparation may take place it is difficult to say. The examination of morbid specimens helps us very little. Clinical observation gives great reason to believe that, under favourable circumstances, scrofulous and tuberculous matter may undergo complete absorption, leaving the tissue which had been occupied by it quite unimpaired; and the inference derived from pathological investigation of similar products in other parts of the body is that they may fall into a quiescent state, the more watery elements becoming absorbed, while the remaining constituents are impregnated with oily matter or saline particles, so that the mass is converted into a substance like putty or soft cheese, or, finally, into a dry earthy lump composed chiefly of carbonate of lime. While these changes are going on, the mass is enclosed and isolated from adjacent parts by a capsule of lymph effused around it. We often see small circumscribed earthy masses in the body of the testicle, perhaps in the corresponding parts of the two testicles, or in the epididymis; and analogy leads to the supposition that some of these are the remnants of tuberculous disease, which has subsided and done little injury to the organ; and we occasionally find circumscribed tuberculous lumps which would be likely to be converted into these earthy masses. The knowledge of such conditions assists us in our practice; for it is not difficult to recognise these masses in the living subject, and we can relieve the patient's fears by the assurance that they are of little importance. Granted that they are of the nature supposed, they must be the result of very limited manifestations of the disease. It might be said that they do not warrant much hopefulness of the favourable termination of a more general invasion of the organ by scrofula. Nevertheless, my own experience of the disease, clinically, makes me very unwilling to condemn a testicle, even though it be the seat of severe and extensive scrofula. It is impossible to know that all the tubules are involved; and I have often been astonished at the good results that have followed, in apparently hopeless cases, from judicious treatment when the circumstances were favourable to the improvement of the health and the subsidence of scrofula. Particularly should this be borne in mind when, as so often happens, both testicles are diseased.

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* See 'Ein Beitrag zur Kenntniss der anatomischen und clinischen Bedeutung der sogenannten Hodentuberkel,' von Dr. Hermann Demme, in *Virchow's Archiv*, vol. xxii. p. 155. Hulke, *Med. Times and Gazette*, vol. xxx. 280.

Diagnosis.—The recognition of the disease is not difficult. The appearance of the patient, the enlargement of the epididymis with thickening of the vas deferens, and, perhaps, enlargement of the testis, followed by slowly forming abscesses without much pain, the pain being chiefly confined to the period when the skin is inflamed, leave usually little doubt as to the nature of the case. Nevertheless, there are cases which deceive even the most experienced; and now and then a scrofulous testicle is removed under the supposition that it is malignant.* The condition of the lungs should be investigated, especially when the patient has the tuberculous aspect. It is also well to inquire into the condition of the urinary organs; and, if there are any symptoms of disorder in them, to examine the state of the prostate and the vesiculæ seminales, remembering that those parts not unfrequently suffer in the same manner as the testicle. Sometimes the disease is more advanced in them than in the testicle, but not commonly.† Hydrocele is not an ordinary accompaniment; but when it is present, the true nature and extent of the disease will probably not be ascertained till the fluid has been evacuated. It is not usually a painful disease. It may be grafted upon an attack of acute inflammation in those who are of scrofulous temperament; and this should be borne in mind in the treatment of epididymitis in such persons, and should induce us to adopt an invigorating regimen as soon as the subsidence of the acute symptoms will permit it. It may be induced by a blow. Often the disease has made considerable advance before it attracts the patient's attention; and he discovers by accident a lump at the hinder part of the testicle, or in its substance. Sometimes the part is painful and tender at the onset, and it is commonly so when softening and suppuration are going on.

Treatment.—The treatment consists, principally, in means calculated to improve the general health and impart vigour to the nutritive processes; and of these, fresh air out-of-doors, and well-ventilated, well-lighted apartments stand first in importance. Unless the pain and inflammation be such as to necessitate repose, the patient should be encouraged to go out, and to select—if it be in his power—a cool, bracing, rather elevated residence. He has less to fear from exposure to wet and vicissitudes of weather than from confinement and inaction. The poor man had better, if he can, remain at his daily out-of-door work than rest in the ward of a hospital. In the case of the town-artisan the importance of this treatment is paramount. It is often the only thing wanted; but, unfortunately, it is often the thing which cannot be obtained, and we have to struggle on feebly with other means. Next in importance is a rather liberal supply of nutritious food—meat and beer—sufficient to satisfy the appetite, not to quench it. At the present day the last caution is much needed; for numbers of invalids are so plied with food that a natural appetite, and the vigorous digestion attendant upon it, are not suffered to exist. Sponging of the part, and of the body generally, with cold water is a useful adjunct. Steel, quinine, acids, cod-liver oil, are often of service. Iodine is thought much of by some persons; but its good effect in this and other scrofulous affections has not been so apparent to myself as it seems to have been to some practical men who have paid much attention to this class of diseases, and whose opinion deserves great weight.

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* *Med. Times and Gaz.* vol. xv. p. 452.

† Report of discussion at la Société Anatomique, *Medico-Ch. Review*, vol. xxviii. p. 272.

The local treatment, though secondary to the general, is not unimportant; and where there is not the opportunity to carry out the measures on which we most rely, we must be the more persevering with those which are less effective. The part should be suspended, if it be painful, and soothing applications made. If it be not painful, it should be well sponged or sluiced with cold water several times a day. This is the best appliance and, fortunately, it is an easy one; but there is often an inattention to it on the part both of the surgeon and the patient. An external stimulant sometimes does good; and iodine, in a fluid form, is more manageable and answers the purpose better than any other application. It should be used so as to produce a slight scaling of the skin. Abscesses may be allowed to burst, especially when they proceed from the epididymis. I do not think much good is done by opening them. In some very bad cases, where the organ seemed nearly destroyed, I have seen very good results from freely laying open the sinuses and cavities, turning out the scrofulous matter and softened structure, cleaning the part by washing and wiping, then freely applying nitrate of silver, and plugging the wound with lint, so as to induce active suppuration. At any rate, it is worth while to try this before determining to remove the organ. The healing of the sinuses which result from the bursting of abscesses cannot be much expedited in any other way. If the disease is not extensive or progressing, they may be left, and in the course of time they will close.

Excision.—We should be unwilling to proceed to extirpation of the organ, unless its presence is a great source of irritation and a drain upon the patient's health, preventing his getting about, and so tending to induce disease in the other testicle, or to aggravate the disease which may already exist there. It is surprising how this organ and other parts do, under favourable conditions, contrive to recover from scrofulous disease, and to resume their functions, though their structure was, to all appearance, completely disorganised. Moreover, it seldom happens that the whole of the glandular tissue is involved; and a small part of this may be sufficient to carry on the requisite function.* When the epididymis and vas deferens have been blocked up by scrofulous matter, or damaged by abscesses, the prospect of recovery to useful purpose is more hopeless. Still it is difficult to decide, for certain, by external examination, to what extent structural disorganisation has taken place; and it is almost impossible to be sure that the tubes are so far destroyed as not to admit of being cleared out by absorption or discharge of their contents, and of being again enabled to afford a passage for the semen.

In considering the question of removal of the organ, the condition of the patient's health is a very important item. If he becomes more and more reduced, in consequence of the irritation and suppuration in the part, and of the confinement imposed by it; and if the local and general measures that are available, and usually serviceable, fail to produce a good effect, there is no alternative but the removal of the diseased part; and we should not be deterred from resorting to this step because of the presence of scrofulous disease in other parts of the body, or by the apprehension that, if it is removed in one place, it may make its appearance at another. I know that this idea is very generally entertained; and I think it is allowed to influence surgeons in their practice more than it ought to do. I do not deny that there may be some foundation for the idea; though I have never felt sure that it is laid very deeply in that which is the only reliable ground, namely, careful and extended clinical observation; and I think the converse statement is at least equally, if not more generally, true, viz. that the *existence* of scrofulous disease in one organ *predisposes* very greatly to its manifestation in others. We can understand that it should do so, not simply in accordance with the rule that disease tends to beget disease, and that disease of its own kind, but because it lowers the general health, and so renders the whole body a more easy prey to that or any other malady; and we find that it does this when we observe the numerous cases in which patients, worn down by scrofulous abscesses of the vertebræ, the joints, or the testicle, fall victims to tubercles in the lungs or the abdomen. It is remarkable that, in the face of these cases of every-day occurrence, the surgeon should still be deterred from relieving the system of a scrofulous organ by the apprehension I have mentioned. Upon the same principle, he should fear to restore a scrofulous organ by any of the ordinary means of treatment. If such a part be clearly a source of irritation and depression to the constitution, there can be little question that its removal will tend to prevent the accession of scrofula elsewhere. I think we may go a step further, and assert that the removal will not only tend to prevent the accession of scrofula but also to promote the restoration of organs which may be already affected by it. I have in several instances seen the health of phthisical patients much improved, and the condition of the lungs ameliorated, after amputation of scrofulous joints, or the excision of scrofulous testicles.

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* When the testis is, to a great extent, disorganised by the effusion of tubercular matter or lymph, and forms an open fungoid sore, secretion may still go on under excitement, as is evinced by the stiffened state of the dressings and a microscopic examination of the discharge. Curling, *On the Testis.*

Cystic Disease,

constituting the 'hydatid testis' of Sir A. Cooper, is not of very frequent occurrence. It resembles that in the mammary gland, the ovary, and the kidney, inasmuch as it consists of an agglomeration of thin-walled cysts varying in size from that of a pin's head to that of a walnut, and of globular shape, modified by their mutual pressure. They are filled with fluid, which is mostly thin and colourless, containing granules, and delicate corpuscles; but which is sometimes viscid and tinged with blood or other colouring matter. They appear to originate in the substance of the gland, but whether in the tubular structure or in the areolar tissue connecting the tubules is not certain.* They form masses attaining considerable size, and weighing, it may be, some pounds. As in the corresponding disease of the mamma and the ovary, the cysts are sometimes more or less occupied or distended by firm, fibrous, lobulated and pedunculated bodies growing into them. These bodies, examined by Mr. Quekett, were found to possess a cellular structure, and to be covered on the surface with cylindrical epithelium, like that covering the villi of the intestine;* or they may contain small, hard, spherical bodies like pearls, composed of concentric layers of condensed epithelium.† A variable amount of fibrous tissue is formed with, and intervenes between, the cysts. In some instances it is of small quantity and delicate; and the mass is then composed almost entirely of cysts. In other instances it is much thicker. It may be so thick as to constitute the chief element of the tumour; and the cysts then look as if they were mere secondary formations. To such the term 'fibro-cystic tumour' has been given.

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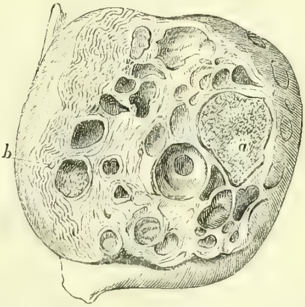
* Mr. Curling, op. cit. p. 322, from the microscopical examination of two cystic tumours, confirms Sir A. Cooper's idea that the origin of the cysts is in a dilatation of tubes. 'In some specimens a tube could be traced to a termination in a dilated pouch. In others a cyst appeared to arise from a lateral dilatation of a columnar tube, or at the extremity of a loop; whilst in the others the

In most of the cases of cystic growth which have been carefully dissected, it has been proved that the disease was not diffused through the organ, but originated and was circumscribed in one part, and that as the tumour grew, the unaffected portion of the testicle was pressed aside or spread out over the mass; so that in some the mass, which is usually spherical, could be dissected or shelled out, leaving a considerable part of the

Fig. 328.



Cystic disease: *a*, blood-clot in one of the cysts; *b*, glandular tissue of the testis.

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dilatation appeared to be uniform.' These dilated tubes and cysts were lined by a tessellated epithelium, and contained no spermatozoa. He concludes that the tubes are not derived from the tubuli seminiferi of the glandular part, or from the ducts of the epididymis, but from the *rete testis*. If the cysts be really formed by dilatation of the seminal tubes, it is remarkable that spermatozoa are never found in them. Billroth (*Virchow's Archiv*, vol. viii. pp. 268, 433) traces the cysts to outgrowth from the seminal canals, herein according with the views of Reinhardt, Meckel, Förster, and others, with regard to the formation of cysts in the mammary gland. In one case he found well-marked, striped muscular fibres in the structure between the cysts, and believes it to have been produced by a growth and metamorphosis of the connective tissue.

Mr. Paget thinks 'it is essentially a fibrous or fibrous and cartilaginous tumour in the testicle, with more or less of cyst formation in the tumour.' —*Lectures on Surg. Path.* by Turner, p. 478.

* Curling, p. 320.

† Virchow, *Archiv*, vol. viii. p. 399.

testicle uninjured. The glandular tissue does not, however, under these circumstances usually contain spermatic filaments or seminal granules.* In other cases, however, although the glandular substance of the testicle could be discerned spread out upon the tumour, and microscopical examination proved its natural structure to be preserved, yet it could not be cleanly dissected away from the tumour. In some cases, also, a certain amount of gland-tissue has been found dispersed through the cystic mass. The epididymis, at first unaffected, becomes flattened, compressed, and wasted.†

Diagnosis.—The disease is most frequent between twenty and fifty ‡ and is not unfrequently the result of injury. Its presence may be suspected when one testicle gradually and steadily enlarges, acquiring an oval or nearly spherical form, and is of moderate weight, heavier than a hydrocele, less heavy than a solid tumour. It feels elastic, but less decidedly fluctuating than a hydrocele. The affection is usually painless, and is unattended with any constitutional symptoms or indications of a predisposition to disease. The absence of transparency forms the chief distinction from hydrocele; and the slow rate of its growth may aid us in discriminating it from encephaloma. The diagnosis, however, from the latter disease, from hæmatocele, and from non-transparent hydrocele, cannot, in some instances, be arrived at with certainty except by the aid of punctures with a good-sized trocar. The instrument may be introduced at several points, and will probably give vent to a small quantity of clear fluid from each, indicating that several cysts have been punctured in succession. A grooved needle or a small trocar does not afford sufficient information, as either is liable to be blocked up by the clots or small flakes of lymph which may be present in hæmatocele or hydrocele.

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* *Med. Times and Gaz.* Sep. 4, 1869, p. 275.

† In a specimen examined by Mr Ludlow (*Trans. Path. Soc.* vol. v. p. 216), the vas deferens, immediately continuous with the epididymis, was impervious and had been converted into a fibrous cord; the cysts were lined by a single stratum of spheroidal epithelial cells, and contained intra-cystic growths of firm fibrous tissue, cells of various forms and stages of degeneration, and some crystals of cholesterine.

‡ A rare instance of its occurrence in very early life, if not congenitally, is given in the *Trans. of Path. Soc.* vol. vii. p. 241. In this instance the cysts were lined with ciliated epithelium, and, in the opinion of the writer of the report (Dr. Carter,) could not possibly be connected with the seminal tubes. There were also osseous spicules in the fibrous tissue, having lacunæ of irregular form and disposition, but no cartilage cells.

Treatment.—Castration is the only remedy; and it may be resorted to as soon as there is evidence of the presence of the disease. It might be thought, forasmuch as the glandular tissue is usually found, in part, healthy and spread out over the tumour, that the latter might be enucleated, and the gland or sufficient of it left to perform its function. It is possible that this might be so in some cases, though it is scarcely compatible with the view that the disease has its origin in the *rete testis.* Supposing there to be only one testicle, and that one the seat of cystic disease, it would be well to cut cautiously down to the tumour, and endeavour to dissect or tear it away from the containing capsule, in the hope of leaving some of the tubuli and the efferent ducts uninjured. In ordinary cases, however, where the other testicle remains sound, the prospect of success from this procedure is scarcely worth the risk of the additional inflammation and suppuration which it entails.

The disease is in itself of a benign nature; is usually confined to one testicle; and when it is so, the patient may live for years after its removal, and have children.

Association of malignant disease.—It has been observed, however, that in several instances the result has been less fortunate; the patient, after the lapse of a few months, being carried off by encephaloid disease of the lungs, absorbent glands, or other parts. This has naturally thrown a suspicion over the cystic affection, and has led many surgeons to regard it as of malignant nature. The truth appears to be that, though really of simple character itself, the cystic tumour is very liable to be associated with malignant disease, and therefore it practically deserves the suspicion with which it has come to be regarded. In these cases, if a microscopical examination of the tumour be made, the character of the disease may be commonly discovered by the presence of cancer-cells in the cavities of the component cysts or in some of them. It is not certain, under such circumstances, whether the disease is originally of cancerous nature, or whether the cysts are, at first, simple, and the cancer-cells are subsequently engrafted on them. Perhaps the former is the more probable, because we find, as a general rule, that growths which are cancerous are so from the beginning, the change from a benign to a malignant character being the exception. There are, however, some features which suggest the other view in these cases. Thus the relative amount of the cancerous to the other elements seems to increase as the disease goes on: and we sometimes find parts of the growth consisting entirely of simple cysts, while in other parts cancer-cells abound, and at certain points the mass presents the ordinary characters of encephaloma.

We learn from this that the prognosis as to the result after an operation in cases of cystic disease cannot be given without reserve, since it is impossible to tell whether the cysts are of a simple character or not. The cases which have progressed most rapidly are to be regarded with greatest suspicion, forasmuch as cystic tumours combined with encephaloma grow more rapidly than when they are of simple nature. Even after the tumour has been removed, a mere examination with the eye is not a sufficient test. The fluid should be taken from various parts of it, and submitted to inspection under the microscope, before we can venture upon an opinion as to the prospect of an invasion of other organs by the disease.

Mr. Curling has noticed the occurrence, in some of the cysts, of a solid whitish matter, exhibiting the characters of cholesteatoma, both in cases where the disease was malignant, and where it was not malignant.

Association with enchondroma.—Another very frequent attendant upon cystic tumours is the formation of cartilage growths; so frequent, indeed, as to have elicited from some pathologists the statement that cystic and enchondromatous growths nearly always exist together. The cartilage usually is in the form of nodules, which appear to occupy and grow from the interior of the cysts. The nodules are sometimes found to be strung together into lines; and this corresponds with the view entertained by Curling, Hogg,* and others, that the cysts are the dilated tubes of the testis or its rete, and that the cartilage is produced in them. In a case examined by Mr. Paget,† the cartilage was disposed in tortuous, cylindriform, and knotty pieces, which appeared as if embedded in filamentous tissue, but were, apparently with good reason, judged to be in the lymphatics of the gland. Further examination of these cases, however, is necessary to decide positively which of the structures is the seat of the cartilaginous growths; whether they originate in the cysts, or in the intervening tissue and sprout into the cysts; if they originate in the cysts, it is still uncertain whether the cysts are diseased and dilated seminal tubes, or diseased and dilated lymphatics, or whether they are formed in the connective tissue of the gland.

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* *Trans. of Path. Society*, vol. iv. p. 180.

† *Medico-Chirurg. Trans.* vol. xxxviii. p. 248.

The cartilage has the external characters and appearance of true hyaline fœtal cartilage, and very nearly corresponds with it chemically and microscopically. The cells are rather smaller, and clustered rather more closely and irregularly, than is usual in fœtal cartilage; and there are usually somewhat greater differences in the consistence and colour of the several parts of the same mass. In some places it may be quite firm, and in others very soft; and, though it is for the most part pellucid and colourless, or with a faint bluish-white hue, in some spots, usually at the centre of the nodules, it is more opaque and yellowish. This may be due to a simple change of colour; or it may indicate that a process is going on allied to ossification, but resembling it less closely than the ossification which takes place in the enchondromatous tumours found in connection with bone. The structure becomes infiltrated in patches with earthy matter, which, if we may rely upon one analysis,* is composed of a large proportion of phosphate of lime; still there are no true bone-cells or canaliculi. The 'calcifying' or 'ossifying' process is observed to have taken place to the greatest extent in those tumours which are of longest standing and of slowest growth; and if the growth were to be arrested, it seems probable that the whole tumour might become impregnated with earthy matter, so as to form little more than a hard concrete mass. I have not, however, met with any specimens in which this has taken place.

I have said that the growth of cartilage is usually consequent on the cystic growth, engrafted upon and subordinate to it, the nodules of cartilage appearing to be developed in the cysts, and forming but a small part of the mass. In some cases, however, the formation of cartilage proceeds so rapidly, exceeding that of the cysts, that the latter become choked up, and the traces of them are nearly lost; perhaps in many parts they are quite lost.* Or the cartilage may be developed in the tissue without there being any intermediate cystic formation. It appears to have been so in Mr. Paget's case. In this very remarkable and exceptional, if not unique, case the disease extended up the lymphatics into the abdomen; a cartilaginous growth projected from one of them into the vena cava, and there were numerous masses of the same nature in the lungs.

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* Mr. Barry found 100 parts of a tumour described by Sir A. Cooper as 'very hard, in some parts cartilaginous, in others ossific,' to be made up of phosphate of lime 45 parts, carbonate of lime with a trace of magnesia, 17 parts; animal matter 38 parts.—*Trans. of Path. Society*, vol. iv. p. 184.

The presence of enchondroma may be suspected by the weight and hardness of the mass. The complication makes no difference either in the treatment or the prognosis of cystic disease. Encephaloma may be associated with it, usually occupying a part of the cystic mass which is free from cartilage, though we sometimes find the nodules of the latter enveloped in the soft tissue of the cancer.†

Fibrous Tumour.—A drawing of what appears to be a well-marked fibrous tumour of the testicle is given by Cruveilhier,‡ who observes that it closely resembled a fibrous tumour of the uterus, or rather the tissue of an unimpregnated uterus. It resisted and creaked under the scalpel. It was composed of contorted and interlaced grayish-white fibres forming lobules, with vessels penetrating their interspaces. It was very heavy in comparison with the size, which was twice the natural size of the testicle. At the upper part of the tumour was a gelatinous mass, which seemed to result from an alteration of the fibrous tissue. M. Cruveilhier has several times observed a similar alteration in the fibrous structure of the uterus. He could discover none of the natural tissue of the testicle, and believes that the fibrous tumour was formed at the expense of the cellular tissue which unites the seminal tubes, and that the proper tissue of the gland was atrophied from compression. In this case there was no microscopical examination, and no sequel is given. The latter especially is necessary to assure us of the real nature of the disease; for, in some instances, where the appearance and minute examination gave the impression of an innocent fibrous or fibrous-cellular tumour of the testis, the favourable prognosis has been soon disproved by the appearance of malignant disease in other parts of the body.

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* In the case described by Mr. Curling, p. 324, 'the enchondroma was developed so abundantly as to encroach upon and obliterate the cysts and to form the chief bulk of the tumour.'

† Dr. Lotzbeck (*Virchow's Archiv*, vol. xiv. p. 394) concludes from the examination of two specimens in which cancer was combined with enchondroma, that the cancer is the after-product and results from a metamorphosis of the cartilage-cells.

The results of 16 cases of cystic sarcoma of the testis tabulated in *Med. Times and Gaz.* vol. xi. p. 395, is as follows: the average age, 40; extreme ages, 18 and 58. Average duration, 21 months; extremes, 3 months and 11 years. Supposed cause, blows in 5. All recovered from the operation. There were cysts in all, enchondroma in 3, cancer in 1, cholesteatoma in 1. The gland-structure was expanded over the tumour in 8, lost in the tumour in 4, not described in 4. The epididymis was healthy in 6, involved in the disease in 3, not described in 6. Intracystic growths were developed in 3.

‡ *Anatomie Pathologique*, 5^{e} livraison, pl. i. fig. 3.

Sir B. Brodie mentions the case of a man who had one testicle enlarged and hard. Though the symptoms were not those exactly of chronic inflammation, he treated it as such, and administered mercury without avail. The testicle was amputated; and the structure was found to be peculiar, like very condensed cellular membrane, of the consistence of ligament. Between six and twelve months afterwards an apparently similar disease began in the other testicle. Under the administration of iodine, internally and externally, the disease diminished.

These examples, and I know of no others more nearly approaching to fibrous tumour, are not sufficient to assure us that this disease really affects the testicle.

Mr. Paget* speaks of a 'fibro-cellular tumour,' removed by Mr. John Lawrence, with the testicle, within the tunica albuginea of which it appeared to be entirely enclosed. The patient was a healthy-looking man, 37 years old; and the tumour had in seven years grown to a measurement of nearly six inches by four. When first removed, it was to the eye exactly like a fatty tumour, but it contained no fat, and was a typical specimen of fibro-cellular tumour in a very œdematous anasarcous state.

CANCER OF THE TESTICLE.

Of the four varieties of cancer usually recognised by pathologists, the 'encephaloid' is of very frequent occurrence in the testicle; a few examples of the 'scirrhous' and 'melanotic' form have been met with;† but I have not found one recorded instance of the 'gelatiniform' cancer of this organ.

Encephaloid cancer presents much the same characters in the testicle as in other parts of the body. It commences most frequently in the glandular portion by the formation of small masses among the tubuli seminiferi. They gradually increase and coalesce, to the destruction of the glandular substance. Sometimes it begins at one point in the centre of the testicle, or in the rete; and the tubuli of the lobules are, at first, spread out over it. It has its origin less frequently in the epididymis. Mr. Wardrop gives a case where the tumour grew from the surface of the tubuli testis, immediately under the tunica albuginea, and Sir B. Brodie one in which the glandular structure of the testicle remained in a natural state, while there was a large fungous tumour completely occupying the tunica vaginalis.* It is only when the tumour is examined in an early stage that we can tell where it began; for all the structures soon become involved and destroyed by the disease, and the whole is reduced to a cancerous mass, in which none of the natural components of the testicle can be traced. The mass has a soft pulpy consistence and, commonly, a more or less uniform white or pinkish-white colour. When squeezed, a creamy fluid oozes from its cut surface at a multitude of points; and if a stream of water be directed upon it, the greater part is washed away, leaving a flocculent, filamentous, areolar structure, in the interstices of which the creamy fluid had been contained. It is usually so soft, and the areolar basis is so fragile, that it is liable to give way in consequence of a slight blow, or without any such cause, and blood becomes effused in its substance. This may take place at many points, interstitially, or into ragged cavities formed by the pressure of the blood; and the effused blood, undergoing changes, gives rise to a variety of appearances and discolorations. Sometimes the fibrous skeleton is thicker and tougher, giving a firmer consistence to the mass and simulating 'fibrous tumour' and it may be arranged in places concentrically, so that the more fluid elements appear as if they were arranged in cysts. Or there may be cystic disease combined with the cancer. It not unfrequently happens also that masses of cartilage are present; and this combination is more frequent in the testicle than in other parts of the body. In a case, a section of which is repre-

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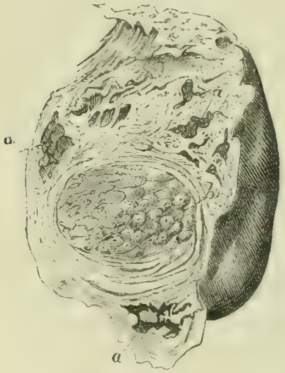
* *Surgical Pathology*, vol. ii. p. 118.

† Mr. Curling mentions two instances of scirrhus, and three of melanosis. The occurrence, however, of true scirrhus, like the scirrhus of the mammary gland, is extremely rare, indeed is almost disproved by the more searching observations of modern pathologists. In *Path. Trans.* xviii. 184 is the report of a case in which hard cancer and sarcoma existed side by side in the testicle.

Fig. 329 *



Encephaloid testicle, with a ball consisting of cartilage nodules, fibrous and cystic structure in its substance: *a a a*, ragged cavities containing fluid and clotted blood, and many-coloured remnants of clots; *b*, hyaline cartilaginous nodules with central opaque spots.

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* This case is related and represented by Sir A. Cooper. One apparently similar is given by Sir E. Home, *Obs. on Cancer*, p. 125.

sented in the accompanying figure, where the testicle had attained to very large size in a year from the time when enlargement was first observed, I found numerous small thin-walled cysts, containing clear serum, scattered throughout the encephaloid structure. They appeared to have been secondary to it, or to have grown together with it. In the middle of the tumour was a hard spherical mass, as large as an orange, composed of compact fibrous tissue with small cysts, some of which contained clear fluid, and others were filled with nodules of cartilage. From the short period during which the testicle had been enlarging in this case, it would seem that the several growths—cystic, fibrous, cartilaginous, and cancerous—had commenced and gone on together. The variety in them, perhaps, depended upon the different structures involved; the more solid elements originating in the mediastinum and rete, and the softer components in the glandular part of the testicle; just as we find cancer of the breast to be associated with a considerable development of fibrous structure, and cancer of the bones to be attended with a marked growth of fibrous and osseous tissue.*

Changes of a different kind, due to degeneration of parts of the growth, may also take place. Softening may occur, producing cavities filled with grumous, pultaceous substance; or the cells and tissue may become impregnated with oily matter, giving a yellow colour to parts. None of these changes are of much practical importance, or affect materially the progress of the disease.

Gradually the mass increases; not, however, quite steadily. There are often periods during which it seems to be quiescent;†

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* In most of the cases of combined enchondroma and encephaloma the two morbid products have not been blended, but as in this case the cartilage has formed a separate mass imbedded in the cancer. The consecutive disease in other parts of the body has usually consisted of cancer unmingled with cartilage.

In specimen 2429A in the College of Surgeons portions of bone-like substance, resembling light osteoid tumour, are imbedded in the mass. I do not know any other example approaching to osteoid cancer in the testicle.

† In a case which lasted more than five years, the slow progress was attributed to the process of retrograde metamorphosis in the centre of the tumour nearly balancing that of growth at the circumference. *Trans. of Path. Soc.* vol. x. p. 205. In another case of similar duration the mass was firmer than usual. *Med. Times and Gaz.* vol. xx. p. 291. The following is given by Mr. Paget (*Surg. Pathology*, vol. ii. p. 394) as an example of arrest or suspension of the progress of

or an actual temporary diminution of size may be caused by absorption of fluid effused during the earlier stages into the tunica vaginalis. The hope thus engendered is only destined to be soon dispelled by the rapid progress of the malady. The tunics of the testis yield under the pressure of the quickly increasing tumour more readily than might have been expected, and become stretched to a very great extent; so that although the tumour may attain to large size, they seldom give way. Sir A. Cooper speaks of the disease making its way through them and projecting as a bleeding fungus through the ulcerated skin, and I have a patient now under my care in whom this is the case; but as a general rule, before there is time for this to have taken place, the testicle has been amputated, or the disease has extended along the spermatic cord to the abdomen, the lumbar glands and other organs have become involved, and the patient has sunk under the depressing and destructive effects of the disease.

Cancer of the testicle makes its appearance at all periods of life, from the earliest infancy * to old age, but is most frequent from twenty to forty. It is rare after sixty. It has been observed in the undescended testicle in several instances (see p. 76).

Symptoms.—Quickly progressing solid enlargement of the testicle, without inflammation, is the great, the almost infallible indication of the disease. Whenever we can make sure, therefore, that this is going on, we may be pretty certain that there is medullary cancer. The enlargement is general, the testis and epididymis being usually blended at an early period. The

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cancer. 'A man 38 years old, had slight enlargement of one testicle for 15 years, and its rate of increase was often inappreciable. At the end of this time rapid growth ensued. On removal, well-marked medullary cancer was found, and was the only apparent source of the enlargement. He died soon after the operation with recurrence of the disease.'

In a case related in the *Lancet*, Aug. 10, 1861, the tumour is said to have grown to the size of a new-born infant's head in sixteen weeks.

* In the College of Surgeons (No. 2401) is the section of a large medullary tumour from the testicle of an infant seven months old. It has been known to exist in several instances in children under two years. See microscopical examination of maligant tumours of the testicle, from boys aged five and three in *Trans. of Path. Soc.* vol. xi. pp. 161, 165. The tumour from the younger boy was judged from the examination to be innocent, 'fibro-nucleated;' the sequel given in vol. xii. p. 164, proved it to be malignant.

part is at first rather firm ; and the firmness is uniform, and the surface smooth. After a time the mass becomes softer, at some parts more than others, so as to have a pulpy, elastic, or fluctuating feel, tempting a lancet-thrust. It is not commonly very tender or painful. If there is pain, it is dull, not acute or lancinating. Pressure does not elicit, at any part, the peculiar sensation of the testicle being touched. The veins of the scrotum become turgid. The cord is free at first ; and the vas deferens can be felt to be natural. Soon the cord becomes thick and full from turgescence of its vessels, perhaps thick and firm from deposit of medullary matter in it. As the disease progresses, the health suffers, the patient becoming weak and thin, with anxious expression. It is, however, important to remark that this alteration in the general health is by no means constant, or even usual, in the early stages, and that it has, therefore, no necessary connection with the malady, but is only a result of the effect of the malady upon the constitution. So much is said and written about cancerous cachexia, that cachexia comes to be regarded as a necessary associate of cancer. Hence physicians and surgeons rely upon it as a means of diagnosis, and conceive that a disease cannot be cancerous because the patient's health is good ; whereas, in reality, cancer, especially in early and middle life—the periods in which the testicle is most commonly attacked—fastens itself often, I would say oftenest, upon those who are well nourished and florid, who seem the most healthy and robust, and, so, give promise of long life and vigour.

Although the diagnosis of medullary cancer may seem to be easy, the mistakes which frequently occur prove that it is not always so ; and there are few surgeons who have not been puzzled, and occasionally foiled, in distinguishing it from non-transparent hydrocele, hæmatocele, and cystic disease, and, in its early stages, from syphilitic disease. If a testicle, which has enlarged quickly, is solid, it is, in all probability, medullary ; but the difficulty, in some cases, is to be certain that it is solid. The weight, the sense of fluctuation, and the history, will enable us to decide this point in many cases ; but we often require the additional information afforded by a trocar or an incision. It is best to resort to the latter, as it affords the most certain information, and is the best treatment in those cases of hydrocele and hæmatocele that are likely to be mistaken for encephaloma.* The diagnosis from cystic disease may be based partly upon the rate of growth, but especially upon the information elicited by the trocar. It is not of so much importance, because the treatment is the same, whether the growth be cystic or medullary, and, as has been already said, the two diseases are often combined. The point of most practical importance, and of greatest difficulty, is to distinguish cancer of the testicle, in an early stage, from enlargement caused by inflammation—simple, syphilitic, and scrofulous. The absence of the symptoms of inflammation is so frequent in inflammatory affections, that this negative symptom helps us very little; and our opinion is rather to be formed by observing the influence upon the swelling of those remedies which are usually of service when it is of inflammatory nature. If we find that the swelling does not yield to antiphlogistic measures, with mercury and iodine, but goes on increasing, we have reason to fear that it may be caused by some growth, malignant or other, in the testicle. The difficulties of diagnosis have been found to be very great when a retained testicle has been the seat of malignant disease.†

The disease usually terminates fatally in about eighteen months or two years;‡ and it does so less by the changes it induces in the testicle than by its effects upon distant organs and upon the constitution. Sometimes the inguinal glands are involved. More commonly it spreads up the cord into the abdomen, attacking the lumbar glands, and giving rise to the formation of masses which compress the vena cava and thoracic duct, destroy the bodies of the vertebræ, press upon the spinal cord or the nerves, or impair the action of the abdominal viscera. The most distant organs also become the seat of its ravages, particularly the lungs. Cancer of the lungs is not a very common affection; but I have observed it to occur more often as a sequence of that disease of the testicle than of other parts. It rarely affects both testicles.

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* The amount of blood which flows through the canula of a trocar thrust into an encephaloid testicle is sometimes so great as to lead to the supposition that it must be a hæmatocele. It is to be remarked, however, that in such cases the diminution of the swelling is not so proportionate to the flow of blood as it is in hæmatocele.

† *Medico-Ch. Trans.* vol. xxx. p. 10.

‡ In *Med. Times and Gaz.* vol. xix. p. 258, two cases are mentioned in which the disease terminated fatally, without operation, four months from the time at which it was first observed in the testicle. Cases have been mentioned in footnote p. 141, in which life was prolonged to five, and even fifteen years.

Treatment.—The removal of the part should not be attempted unless there be a fair prospect of taking away the whole disease. If it has spread up to the inguinal canal, or if there is a tumour in the abdomen, it is not worth while to subject the patient to an operation.* After complete extirpation, the prospect is no better than after similar operations for cancer in other parts. Indeed the tendency to secondary disease seems to be remarkably strong when the testicle has been the primary seat of cancer; so that the encouragement to surgical interference is not great; and the most that can be said is, that life may be prolonged thereby a little. One patient lived four years, under my observation, after the removal of a well-marked medullary testis, and died, as we believed, of phthisis; but a post-mortem examination was not obtained. Sir B. Brodie heard of one patient alive and well three or four years after the operation. Mr. Curling relates four cases in which the patients were well at the respective periods of ten, four, nine, and twelve years after the operation; and quotes four others from Dr. Baring of Hanover, in which considerable periods had elapsed without return. Mr. Cock mentioned the case of a man whose testis he removed for medullary cancer, who was in good health six years afterwards, and emigrated to Australia.†

It is to be observed that the presence of cartilage cells or masses of cartilage may be commonly detected in the secondary or the recurrent form of the disease, when cartilage exists in the primary formation. See cases of this kind reported in *Med. Times and Gaz.* May 1869, p. 503.

CALCAREOUS, OSSEOUS, AND OTHER FORMATIONS.

Mention has already been made of the formation of calcareous flakes or masses in the testicle and its coverings.

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* It would seem that quite sufficient attention is not paid to this point. Of 36 cases collected in the *Medical Times and Gazette*, vol. xix. p. 258, three died within a week, and cancer was found in the lumbar glands; two died within six weeks, and two within three months of the operation. There was, in each, disease of the lumbar glands, or lungs, or both. In a specimen in St. Thomas's Hospital Museum the cord is healthy for an inch and a half above the testis, and then is expanded by encephaloid disease, which was not discovered before the operation.

In *Path. Trans.* xvii. 180 is recorded a case in which both testicles were removed for sarcocele supposed to be of malignant nature.

† *Med. Times and Gaz.* vol. xix. p. 287.

They are generally the result of the earthy impregnation of lymph or scrofulous deposits. It is not uncommon to find them in the tunica vaginalis as spots, streaks, or flakes, occupying, perhaps, a considerable part of the tunic. It may be in the form of fine sand on its surface; or there may be rough nodulated lumps in its cavity, consequent on changes taking place in lymph effused there. Sometimes they are in the substance of the testis or the epididymis; and the whole of the gland has been converted into an earthy mass. I am not aware that these deposits have been traced to a gouty cause, or that they have been found to consist of uric acid in combination with an alkali. Now and then the vas deferens has been discovered choked with earthy matter, or to have undergone calcareous degeneration in a greater or less part of its length.*

Bone, skin, hair, teeth.—Like the ovary, the testicle is occasionally the seat of dermoid cysts, having much the structure of true skin, with cuticle, hair-bulbs, and sebaceous follicles, and containing the products of these structures, viz. epithelial scales in various states, hairs, and waxy or oily matter. Sometimes, in addition, masses of bone, with or without teeth, are embedded in the wall of the cyst; and there may be other solid matter, fibrous or cerebriform, with cavities containing fluid of various colours and consistence. The osseous masses, which may consist of true bone, are generally of irregular shape, and uneven on the surface; and the teeth, which may have crowns and fangs like ordinary teeth, are commonly crooked and disposed in a disorderly manner, quite unlike the teeth in a jaw. These tumours have, in most instances, been observed soon after birth, and are, probably, usually congenital. The rate of their increase varies a good deal. Sometimes they do little more than increase *pari passu* with the growth of the individual; or they may grow at a somewhat quicker rate; and they are liable to sudden accessions of increase, which may be due to an injury, and may be attended with inflammation. The inflammation has, in one or two instances, gone on to suppuration; and the bursting of the abscess has been attended, or followed, by the discharge of oily matter, hair, teeth, or bony fragments. In the greater number of recorded cases these masses appear to have been developed in the testicle; but it is not certain, from the description of other cases, that this was so; and in the one described by Velpeau the tumour could be dissected from the testicle, which was slightly atrophied.

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* Mr. Gamgee (*Surgical Researches*) has collected numerous examples of 'calcification and ossification of the testicle and its appendages in men and animals.'

In accordance with the views of Geoffroy Saint-Hilaire, these tumours have been thought by most pathologists to be due to 'fœtal inclusion;' that is to say, it is conceived that the more or less imperfect germs of a second fœtus have become included in the testicle during development. It may, however, well be doubted whether such a process ever takes place; and the probability of its being the cause of the formations in question is, to my mind, very small. They are far more likely to be the result of departures from the natural formative processes in the testicle at a period when the developmental forces are in activity and when morbid products are more prone to be composed of natural structures than they are when occurring at subsequent periods of life. Moreover, the peculiar function of this organ and of the ovary may predispose either gland, under certain circumstances, to the evolution of some structures which, in the natural course of things, should result from the combination of their secretions. The '*hétérotopie plastique*' of Lebert, in other words, the production of these structures by forces existing in the part, is, I think, more in accordance with other teratological and pathological phenomena than the '*inclusion*' theory of Saint-Hilaire.

The only treatment is extirpation, which should be performed if the tumour increases or is a source of inconvenience. The tumour is not likely to be of malignant nature, nor to be followed by any disease of that kind in other parts. In none of the cases which have been recorded, however, has the sequel been sufficiently given to determine this point. It is quite possible that encephaloid disease may be engrafted upon it, and may have been, in some instances, the cause of the more rapid increase of size. In performing the operation, it should be remembered that the testicle may be free, and that in one case (Velpeau's) it was left uninjured, though the patient died of purulent infection.*

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* Dr. Verneuil (*Mémoire sur l'inclusion scrotale et testiculaire,* republished from the *Archives générales de Médecine,* juin, 1855, et suivants) describes one case, and has collected nine others. He advocates the inclusion-theory very strongly, arguing much from the resemblance of some of the products to bones

The *operation of castration* is very simple and easily performed. Yet, to perform it well and to insure success, as far as possible, it is necessary to attend to some minor points. The incision, commencing at the external ring, should go quite to the bottom of the scrotum, so as to afford a drain for fluids that might otherwise accumulate in the wound.* It is seldom necessary to remove any skin; but if it be desirable, a good deal may be cut away without interfering with the healing of the wound. The superficial structures having been reflected from either side, an assistant should hold the cord between his finger and thumb, to prevent its escaping into the inguinal canal after its division. This is most likely to occur when the testicle, being large and heavy, has dragged the cord down. A good deal of trouble has, in some cases, ensued from neglect of this precaution, it having been found necessary to cut into the inguinal canal in search of the cord; and this has been followed by peritonitis. When the testicle is not large, or when the cord can be divided at some little distance from the inguinal canal, there is no fear of disappearing; and in such cases, I have operated quite alone, without any assistance, and have experienced no difficulty. In dissecting out the testicle, the raphé of the scrotum and the penis are to be avoided. Some pains should be bestowed on the process of securing the blood-vessels of the cord and of the scrotum; for unless this can be carefully done, there is liability to hæmorrhage after the patient is in bed. I suspect that secondary hæmorrhage after operations may, in this and almost all operations, be prevented by properly securing the vessels at the time. The vessels of the cord should be tied separately. There are usually two, the

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and other parts of the fœtus. In considering such a question, however, we must take the observations with some reserve, and must make some allowance for the imagination of anatomists and pathologists, which has always shown itself remarkably fertile in resemblances of that sort. Similar tumours have been found in the horse's testicle by the late Mr. Bowles of Cambridge. Indeed, I believe structures of this sort—natural structures—are more liable to be developed abnormally in the lower animals than in man.

Tilanus (Schmidt's *Jahrbücher*, c. 171) describes a congenital cysto-fibroid of the testicle removed from a man aged twenty, containing hair, sebaceous glands, well-developed cartilage, and bone.

* To secure better drainage, Aumont proposed to make the incision along the hinder part of the scrotum instead of in front, and the plan has been adopted in England; but it must be attended with some inconvenience, and is not necessary.

spermatic and deferential arteries; there may be more. It is a bad practice to include the whole cord in one ligature; first, because unnecessary pain from tying the nerves is likely to be so caused; secondly, because it is never safe to include much tissue in the knot with an artery. When this is done, it is probable that the division of the inner coats of the artery by the thread, which conduces much to the closure and healing of the vessel, may not be effected; and then, after a few days, the included tissue, softening and becoming absorbed, may leave the ligature loose and the vessel free to bleed. I have several times attributed, and I believe correctly, secondary hæmorrhage to this careless mode of tying vessels.* The interior of the wound should be roughly sponged, over and over again, to remove clots and cause the vessels to bleed; and all that do bleed with any briskness should be tied. The surgeon should endeavour to tie them all at the time of the operation, and should close the wound while the patient is under the influence of the chloroform. It is often recommended to leave the wound open for a few hours, because of the probability of hæmorrhage. This plan tends to make the surgeon less painstaking in tying the vessels; and when it has been followed, I have often found that bleeding has occurred, and it has been necessary either to administer chloroform again, or to put the patient to much pain in securing the vessels and closing the wound. The edges of the skin should be approximated with sutures; and no other dressing of any kind should be applied, no plaster, no compress, no bandage. For many years I have followed this plan in the treatment of wounds after operation, with very few exceptions, after amputation, hernia, breast-excision, &c., leaving the wound quite uncovered, and have made some efforts to impress upon others the advantage of it. I am glad to find the practice is being adopted in some hospitals, and feel sure that in time it will be universal. No dressings being applied, there are none to be removed and re-applied; the wound is kept cool, and can easily be kept clean and pure, and discharges find a ready escape. If anything goes wrong, it is at once detected, and the removal of a stitch or slight opening of the wound will give vent to matter and relieve the part; or a poultice may be applied. A poultice is better than lint under oil-silk, being softer, and adapting itself more completely to the inflamed surface. The general treatment must depend upon the habits and requirements of the patient in each particular case. I never operate upon a florid, robust person—especially after middle life—if I can help it, without some previous preparation by aperients and regulated diet; and believe that by this precaution erysipelas, so-called pyæmia, and other ill consequences may often be prevented.

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* In a case where hæmorrhage ensued profusely an hour after tying the cord *en masse*, and other expedients failed, the bleeding was finally arrested by a large Signorini's tourniquet applied so as to compress the cord on the pubes. *Med. Times and Gaz.* vol. xiv. p. 339. The écraseur has been used to divide the cord, but is not to be preferred to the plan of cutting it through and tying the vessels separately. Moreover, experience tells us that, though bleeding may not occur at the time, it is liable to take place a few hours after the use of the écraseur.

[Though I leave the above paragraph as it stood in the former edition, I must add that since it was written I have seen cause to deviate from the practice there advocated in two particulars. 1st. I rarely now use the common ligatures, employing either the carbolised catgut, or more usually resorting to torsion, which, if carefully employed (it requires more care and patience than the ligature) is generally sufficient. 2ndly. After the vessels have been secured, I sponge the surface of the wound well with carbolic acid. I do this, not as a thorough convert to the antiseptic views, but because I think that the wounds heal better and more quickly when this is done.]

The surgeon should ascertain whether there be hernia on the side to be operated on, and if there is, the extent to which the sac descends upon the cord; and he must be careful not to interfere with it. It may be necessary to dissect the cord from behind the sac. I was fully impressed with the need of caution in this particular by finding, after the operation of castration had been performed on the dead subject in lecture, that the lower part of a hernial sac had been removed with the testicle. Sir E. Home relates a case in which the dressings were forced off by a protrusion of the intestines during a fit of coughing.*

A fatal result has not followed in many cases, and in some of these it might have been prevented. For instance, it has resulted from hæmorrhage in consequence of retraction of the cord before the vessels were secured, and from peritonitis occasioned by searching after the retracted cord. More frequently the cause of death has been erysipelas,* or suppuration in other parts of the body (pyæmia).

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* Mr. Curling 'removing a large carcinomatous testicle, accidentally opened, in dividing the spermatic cord, a hernial sac containing a small piece of omentum, of the existence of which he was not aware. A compress was applied at the groin, and no ill effect followed.'

Functional Disorders of the Testicle.

An interesting and important, though difficult and rarely discussed, point in physiology is the relation of the generative apparatus to the moral character, and the degree in which the former is subservient to and regulated by the latter. I think it would be found that it is so to a very great extent, to a greater extent, perhaps, than is usually recognised; and it is desirable that practical men should pause awhile upon a question of this sort, and not hastily commit themselves to opinions which may have much influence upon the well-being and happiness of society. There are no organs so much under control as those of generation. Their functions are neither directly nor indirectly, in the least, essential to life, scarcely even to the well-being of the body; indeed, which is more remarkable and unusual, they are scarcely essential to the maintenance of the structure of the organs themselves in perfect integrity. The functions of the testicle, like those of the mammary gland and the uterus, may be suspended for a long period, possibly for life; and yet its structure may be sound and capable of being roused into activity. In this respect its qualities peculiarly adapt it for subserviency to man's moral nature. Not that it yields a tame and easy submission. By no means. That stern struggle between the moral and the physical is one of man's greatest trials; a trial which it may be presumption voluntarily to encounter, yet a trial which is, at some time or other, laid upon most men; and t is some satisfaction to know, that if the victory be with the moral, it is not necessarily at the expense of the physical. It s, perhaps, partly with the view of giving strength for this control, or rather, of disarming the antagonist, that the advocates of celibacy among the clergy are usually the advocates also of stringent and regularly repeated fastings.

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* Two fatal cases of erysipelas are reported in the *Med. Times and Gaz.* vol. ix. p. 256. In both there was malignant disease of the lumbar glands. Of 6 cases of castration for malignant disease reported in that journal, 26 recovered; he number of deaths was greatly dependent upon the invasion of other organs y the disease, and the consequent cachectic state of the patients: the propor-ion of recoveries when the disease was not malignant was 26 to 1; a low form f phlegmonous erysipelas was the cause of death in the one fatal case.

The earliest and most frequent cause of disorder of the generative apparatus is the practice of self-abuse, the tendency to which is strongest about the age of puberty. At that time there is considerable excitement about these organs, increased, perhaps, by the conversation and thoughts which are indulged in; and it is apt to be unchecked by the moral control, which has not yet acquired its proper influence. Moreover, lads are often induced to the pernicious practice by their companions, who may be as ignorant as themselves of the wrong and mischief they are doing. It would be a very good thing if those who have the charge of boys were less scrupulous in giving warning upon this matter. Much trouble and anxiety might be spared by timely advice seriously and kindly given. From no one could this come better and with more authority than from the medical attendant, who often has, or may find, an opportunity of giving a hint in time; and, if I am not much mistaken, his kindness will generally be well appreciated. An extensive acquaintance, through years, with those who have just come from our schools, has impressed the importance of this matter upon me. Often, unfortunately, the habit is commenced at an earlier period than I have mentioned, as early, perhaps, as the age of ten or twelve. The pernicious effects are evinced *first* in inducing a weakness and irritability in the organs themselves, with nocturnal emissions, or emissions occurring during the day under slight excitement, imperfect or transient erections, premature ejaculatio seminis, &c.; *secondly*, in a general enfeeblement of the frame and disorder of the various functions, in indigestion in some of its many forms, palpitation of the heart, nervousness and impairment of the mental vigour, epileptic and amaurotic symptoms, or even paralysis; *thirdly*, in its influence on the character, in a lessening of the moral courage and the engendering a tendency to shyness, hypochondria, reserve, and solitariness. The mind becomes engrossed with the one subject; and this unfits it for high thought and bold resolve. The man is lowered in his own estimation by the consciousness of yielding, or having yielded, to a secret habit, and is haunted by the thought of the mischief he has entailed on himself. He seeks the advice of a medical man, yet shrinks from divulging the real cause of his maladies, while he excites suspicion of it by his fidgety absent manner and downward glances.

The symptom about which we are most frequently consulted is nocturnal emissions. The occasional occurrence of these is of no consequence, and the patient may be assured to that effect; but when they return more than once in a fortnight, and especially if they amount to two, three, or more, in a week, as is sometimes the case, they should receive attention. According to my own experience they are much more frequent in the middle and upper than in the lower ranks of life, and especially in those who are of studious and sedentary habits, and are anxious respecting the result of their studies. They are often associated with indigestion and turbid urine. They cause prostration both of body and mind; achings in the lower limbs and back, sometimes a flow of light-coloured urine and irritability of the bladder. They are a source of great mental anxiety. This is increased greatly by the perusal of publications upon the subject, which are freely circulated among young men for the purpose of rousing their apprehensions and inducing them to resort to the authors of these publications, by whom their worst fears are confirmed, and incredible sums are abstracted for promised cure. Hence I commonly find that to the real effects of the malady are superadded others more or less imaginary suggested by what has been read, such as loss of memory, inability to fix the mind upon any subject, palpitations, dyspnœa, &c.

Treatment.—The attention to these sensations, real and imaginary, and the constant dwelling upon the matter, tends, unquestionably, to aggravate the malady. My first effort, therefore—having requested the patient to burn any book or pamphlet he may have upon the subject—is to restore a calm and less anxious frame of mind, by assuring him that great part of his apprehensions are groundless; giving him good hope of recovery, in great measure at least; recommending him to engage in outdoor amusements and to enjoy the cheerful society of his friends; not to relinquish his reading, but to work less hard at it, especially towards night; to go to bed early and rise early. I am unwilling to keep up the idea of invalidism by prescribing medicine or particular diet, and simply warn him against overloading the stomach, as that is likely to induce the discharges. These assurances and simple directions are often sufficient; and many have told me of the relief and happiness they have derived from them. This failing, and in worse cases, more particular attention must be paid to the digestive organs and their secretions, especially when the urine is turbid; mild aperients may be required to prevent accumulations in the intestines, and a light diet must be enforced. In those who are robust, an alkali may be given at night; and in those who are weak, quinine or steel. Better than all medicines are relaxation from work, with change of air, travelling, and sea-side residence. Often, however, these cannot be carried out, or are available only for a time; and under the medicinal treatment the discharges are sometimes not sufficiently diminished. Perhaps the intervals between them are lengthened; and they return two or three nights in succession, instead of being more frequent and with more regular intervals. I have not found cold ablutions do much good; though washing the exterior of the glans penis, and keeping it clear of secretion, is of some service by lessening the irritability of that part.

The application of nitrate of silver, by means of the porte-caustique, to the hinder surface of the prostatic part of the urethra, where the ejaculatory ducts open, is unquestionably, in some cases, an efficient adjuvant to the means just described for checking or moderating this malady. It has been employed by many persons since it was brought prominently into notice by Lallemand; and I do not know that mischievous results have attended its use in competent hands. Care should be taken that the instrument is sound, for the solder connecting the part which carries the caustic is liable to be decomposed. This once gave way, leaving the end of the instrument and the caustic in the prostate of a gentleman whose urethra I was cauterizing. It was voided with the urine in the course of the following day; and, though he suffered more than was intended, no evil resulted. The caustic may be applied pretty freely, the instrument being known to be in the prostatic region by the distance to which it has been passed, and by the sensitiveness of the part, or, more certainly, by feeling with the finger in the rectum. A good deal of irritation, pain, with frequent bloody micturition and some discharge follow the operation, with, perhaps, seminal emissions at night. These subside in a few days, and the good effect is, at once, shown by a cessation of the emissions. In many cases, however, they return after a period, requiring a repetition of the remedy, perhaps two or three times; and in some cases no good results from it. I am aware that this proceeding is objected to by some whose opinion deserves attention as unsafe, by others as empirical, and by others as unphysiological and unpathological. It can scarcely be regarded as unphysiological, when we observe the effect which is produced on the whole length of a tube or a series of tubes by irritation at any one part of the lining membrane, especially if that part be near an orifice; how titillation of the fauces will cause vomiting, or of the larynx coughing, or of the rectum diarrhœa and tenesmus. It cannot be very unsafe or even injurious, or we should ere this have heard of more ill-effects produced by it. Neither do I think it so empirical and unpathological as some seem to regard it, mistaking, as I cannot help fancying, the real seat of the malady, which appears to me to be in the prostatic part of the urethra more distinctly than in any other portion of the generative apparatus. I judge this to be so, because there is usually a preternatural sensitiveness of that part elicited by the passage of instruments, or by pressure with the finger. Frequently there is uneasiness or actual pain there, especially after the emissions; and an irritation of this part by any cause is likely to induce the emissions.* It is the only part in which anything distinctly abnormal in the sensations is experienced; the testes, vasa deferentia, vesiculæ seminales, show little or no tenderness or other sign of disturbance. We are, therefore, warranted in considering this part to be at fault, and in applying to it that salt which is often found to allay irritability or a chronic inflammatory condition in other mucous membranes. Above all, there is the more cogent argument that good frequently results from its use. We must not, however, be too sanguine in our expectations, for, as has been already said, the benefit is sometimes only temporary, and in some cases the treatment fails altogether. In some slight cases benefit is derived from the occasional passage of a metallic instrument into the bladder, and allowing it to remain there ten or twenty minutes. It is commonly well to try this before resorting to cauterisation.†

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* In each of three aggravated cases examined by Lallemand and Curling, 'the mucous membrane of the prostatic part of the urethra was swollen and injected. The prostate was nearly destroyed, and converted into a multilocular abscess, or a number of alveolar cells, communicating with each other; and the diseased mucous membrane covering it was riddled with holes, formed by a considerable enlargement of the original orifices of the gland, through which pus or altered secretion freely escaped on pressing the prostate.' 'One or both vesiculæ seminales were infiltrated with pus, and their walls thickened by inflammation. The orifices of the ejaculatory ducts were enlarged and abraded.'—Curling, *On the Testis*, p. 391.

† *Castration in erotomania.*—The following note from Dr. Bell upon this subject in the *Boston Medical Journal*, vol. lxi p. 166, and *Med. Times and Gaz.* gives an estimate of the effect of the operation in these and the allied cases

Accompanying this malady, or independent of it, there is sometimes a discharge from the urethra of tenacious fluid, like

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for which it has been proposed. It is occasionally successful, but often does no good. 'I have often been consulted as to tying the spermatic arteries, the vasa deferentia, and removal of the testes, in the forms of insanity connected with spermatorrhœa. I have known it done repeatedly. In one case Dr.—— castrated a clean-gone onanist, who subsequently rallied, became an active man, and the doctor told me that he never met him that he did not receive his blessing for the great favour that he had conferred on him. In another case of self-perpetrated castration under a similar state of mind, entire restoration to peace of mind and energy was produced. On the other hand, in all the Lunatic Hospital cases where I have known it done, no valuable results have followed. At the Ohio Hospital, some years ago, it was tried on quite an extensive scale. No case of improvement followed; indeed Dr. Awl told me that in one patient who previously was quiet and contented, a permanent and dangerous condition of irritability followed.' These remarks correspond with the result of Mr. Holthouse's case read before the Medico-Chir. Society, March 22, 1859. In that case the epileptic seizures returned as before the castration. It should be remembered with reference to the operation in these and similar cases, that the fluid emitted is not formed, altogether, by any means, by the testes, but merely acquires its fecundating qualities from the secretion of the testes; and that therefore, the immediate object intended by the operation—the prevention of emissions—really is not effected in many instances, at any rate for some time after the operation. The emissions are not dependent upon the testes, but upon an irritable state of the genital organs; and they may continue, and be as prejudicial, although there be little or no semen in the fluid evacuated.

Dr. Bacon, however, of the Cambridgeshire Asylum, in a paper on Epileptic Insanity (*Practitioner*, June 1869), states his belief that in 'seven of every ten cases of chronic epilepsy in the male sex, the genital organs are the great sources of excitation, and generally, from the morbid state in which they are kept by the bad habits of the patients.' He believes castration to be the only effective mode of quieting this state, and so alleviating the epilepsy and improving the mental condition in some cases, though in others careful supervision and treatment may do much good. He relates the case of a lad aged eighteen, in which the operation was followed by marked improvement in health and intelligence, and diminution or cessation of the fits; and he informs me (eighteen months after the operation) that the improvement has continued, and that since the operation, the fits have not recurred with more than a fifth of their former frequency. In another case, that of an idiot, aged sixteen, with marked sexual excitement, and very frequent masturbation, the removal of the testes eighteen months ago has been followed by great improvement in these respects.

Mr. Chapman (*Med. Times and Gaz.* vol. xviii. p. 377) gives the case of a great sufferer from seminal emissions, with failing health, palpitation, dimness of vision &c., who had one testicle removed in 1840, and the spermatic artery of the opposite side tied and divided, and more than an inch of the vas deferens removed in 1841, without benefit. Three months after the last operation the remaining testicle was removed. In 1848 he felt himself far better in all respects than before the operation; his eyesight was excellent; but he still was feeble, had weakness in the loins, and was a great sufferer from indigestion white of egg, in small quantity, following the urine, or expelled during the evacuation of the fæces, especially when straining is required for that purpose. This symptom causes great alarm to the patient, as he conceives that he is suffering from a continual escape of the semen. Such, however, is not the case. I have examined this fluid passed by several persons, and have never found any spermal elements in it. It proceeds apparently from the prostate gland; and its presence in sufficient quantity to issue from the urethra is an indication of a relaxed condition of the ducts of the gland, permitting the secretion to be expressed during the voiding of the urine or fæces. It generally ceases or diminishes under a tonic regimen and attention to the state of the bowels.

The same trains of symptoms which follow the noxious habit just mentioned may be induced by excessive indulgence in venery, though they are not often so enduring, or attended with so much mental depression. They are not uncommon, in greater or less degree, soon after marriage. They occasionally result also from gonorrhœa, when the inflammation has extended to the hinder part of the urethra, and left a morbid irritability there. The general plan of treatment is much the same, whichever may have been the cause.

The commonly-received opinion that the debility and other symptoms experienced in these cases is due chiefly to the loss of spermatic fluid is a mistaken one; forasmuch as the exhaustion consequent on the emission bears very little relation to the quantity of the fluid discharged, or to the amount of spermatic elements contained in the fluid. As the disorder progresses, and the emissions are more frequent, the proportion, indeed the actual quantity, of spermatozoa decreases, the discharge consisting chiefly of the secretions of the vesiculæ seminales and the prostate gland. The drain upon the system is rather through the nervous system than through the testicle; and the exhaustion experienced after each occasion is consequent upon a loss of nervous force rather than upon a loss of the secretion of the generative organ.*

The question of impotence, with its contingent,—the unadvisability of matrimony—is one on which it is difficult to write, inasmuch as there is not much very definite to be written. In deciding it, it is usually necessary to allow a considerable margin for the nervousness of the patient. A quiescent state of the organs, consequent on long control of the passions, is not to be regarded as an obstacle, because they may be roused into activity when appropriate circumstances arise; and after a long continuance and frequent repetition of nocturnal emissions, the organs usually retain sufficient vigour to admit of improvement under the influence of matrimony. It has happened to me often to be consulted on this subject; and I have very rarely felt it necessary to give a discouraging opinion. In the case of one gentleman, who from early life had been subject to very frequent emissions, who had long ceased to have erections or desire, and whom a variety of treatment, including cauterisation of the urethra, conducted by different persons, had failed to give relief, my advice was that he should remain a bachelor. Very soon afterwards he married and had a family. It has been recommended that in doubtful cases the *experimentum* should be made *in corpore vili.* This appears to me to be useless as well as wrong; for the experiment thus made as a test is no real test, and, as might be expected, has ended in disappointment. I know a gentleman, in every respect, as I believe, well qualified to be a husband, and at one time anxious to be so, who has been prevented from marrying by the failure in this test, to which he, most reluctantly and needlessly, assented, in deference to the advice of an eminent surgeon whom he consulted. The indications derivable from external appearance are of little value; and suspicions based upon them have repeatedly proved to be groundless. There are certain obvious disqualifications, such as imperfect formations or diseased conditions of the necessary organs, and an entire absence of erections or desire. Where such disqualifications exist, matrimony is rarely contemplated. Where they are absent the surgeon is seldom justified in giving an unfavourable verdict; the instances being few in which, by judicious treatment, the patient may not be fitted for matrimony.

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* It appears from the observations of Lallemand that though the semen may be abundant and of the usual odour, the spermatozoa are liable to be deficient in quantity. This is not altogether confirmed by Liégeois, *Med. Times and Gaz.* Nov. 6, 1869, p. 543.

To the encouragement to matrimony it is well to add the hint that though, for various reasons, the rite may not be at first consummated, yet that, in all probability, it will be so before long. This may prevent unnecessary disappointment or despair. I have known premature separation carried out, indeed hurried on by the medical man, when there is reason to think that a little management and patience might have resulted in a happy union. The whole of this question is fraught with so much anxiety and excitement to the person concerned, that the mind is liable to be thrown off its balance, and the most deplorable consequences to ensue. In some case, doubtless, there is cause for the anxiety; but in many the apprehensions are groundless; and happy is it if a man when thus racked with doubts can bring himself to make a confidant of, and disburden himself freely to, some judicious medical adviser, who will calmly enter into his case and acquire his confidence, who will assure him that such cases are not uncommon, and will, perhaps, give him the often-quoted recommendation of Hunter,* to make up his mind to abstain for a time In all such cases it is necessary to take the general state of the health into account; for any debilitating cause, such as dyspepsia, diarrhœa, mental anxiety, &c.—especially when there are phosphates or oxalate of lime in the urine—is liable to be attended with inability, which may be only of temporary nature, and will yield to appropriate treatment.

As a general rule, in the healthy person, the recurrence of desire and power, more particularly the former, decreases gradually with advancing years. Sometimes it does not cease till a late period. This, however, varies much. In those who have abused the organs, or indulged their amorous propensities to excess in early life, the cessation takes place sooner than in others. We learn that the lords of the harem are not unfrequently impotent at thirty or forty; and in this country the same occurs to persons who have been addicted to excite the organs preternaturally by giving way to lascivious thoughts, and in other ways. Any debilitating influence, whether it be mental depression or enervating bodily disease, indigestion, phthisis, diabetes, &c., produces more or less of the same effect; and it has been remarked by Mr. Curling that the 'testes of persons who die of chronic lingering diseases are almost invariably soft and inelastic. When incised, their internal structure seems to contain but few blood-vessels, is pale, apparently shrunk and dry, and the little fluid that can be squeezed from it is destitute of spermatozoa.'† It seems also that long-continued continence induces an earlier cessation of the capability of function than does moderate indulgence. And after long disuse the attempt to rouse these organs into activity at a late period of life, even if successful, is not altogether without risk to the general health. The excitement consequent on it is liable to induce much prostration, which may be followed by paralysis, amaurosis, affection of the heart, or other disorders. I suspect there is foundation for the remark that these ill-effects are more likely to occur in the case of widowers marrying after a considerable interval, than in those who have not been before married. 'Sexual indulgence late in life seems also to promote the enlargement of the prostate gland; and I know of several instances of old men being attacked with retention of urine from congestion of this organ, occurring after coition.'*

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* *Treatise on the Venereal Disease,* p. 203.

† Mr. Gulliver (*Med.-Chir. Trans.* vol. xxvi. p. 93) finds the seminal tubes in old age and after lingering diseases 'often more or less obstructed by

A moderate indulgence in sexual intercourse, especially when the affections are involved, tends to promote the general health and vigour. There are cases, however, in which even this cannot be borne, and in which the nervous exhaustion that ensues warns that abstinence is necessary.

I know an instance in which an apparently healthy man, aged about forty-five, suffered so much depression, with staggering and partial loss of vision, after each connection with his wife, that being unable to restrain himself, he urgently demanded and submitted to castration. He lived many years afterwards in the enjoyment of perfect health, and in the conviction that the mutilation to which he had submitted had been the means of preserving his visual organs, if not of saving him from general paralysis.†

Non-ejaculation or want of emission of semen during copulation is an occasional cause of the inefficiency of the act. A gentleman of spare frame, but enjoying good health and strength, has never been able to effect complete intercourse with his wife in consequence of this defect. Erections occur; but, however long the attempt is continued, emission does not take place. This will, however, often occur afterwards during sleep, and at other times, but is not

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fatty matter, which occurs in free globules, and in more equally-sized and minute molecules, aggregated into comparatively large rounded or irregular masses, nearly opaque, and of a brown or dull yellowish colour.'

* Curling, p. 370.

† I may add that for a year or more this gentleman continued, as in the instance recorded by Sir A. Cooper, to have connection with his wife and emissions much as before the operation, though less frequently; so that his wife was not aware of any change till he informed her of what had been done. After about a year desire gradually ceased. The good effect here commenced soon after the organs were removed, although the excitement and emissions continued for some time. Another man, who had lost both testes, told me that loss of desire and power followed very soon.

excitable by the proper stimulus. He was subject to rather frequent nocturnal emissions before marriage. There is no other symptom. A variety of treatment has been tried by myself and others who have been consulted, without avail, such as tonics, with and without strychnine, belladonna, and blisters to the perinæum, the passage of a steel sound, cauterisation of the urethra, and galvanism. I endeavoured also to increase the irritability of the external parts by slight stimulating applications to the glans penis, the perinæum, and the region of the anus. I have met with other similar cases. One under the name of Aspermatism is related by Dr. Van Buren (*New Orleans Journal of Medicine*, April 1869) in which the prepuce was removed without any good result. The *Traité de l'Impuissance* of Dr. Roubaud and a few other cases are referred to.

Impotence sometimes follows injuries of the head. Cases of this have been collected by Mr. Curling,* who remarks that when it depends upon that cause, 'the prospect of relief is far from being promising. The event itself is one of the last to be detected, and is rarely perceived till all treatment of the injury has ceased, and the patient is in progress of recovery. In some instances it is first announced by the visible wasting of the testicles. When otherwise, however, the surgeon must not despair of the patient regaining his sexual powers as the other effects of the injury disappear.' Sometimes it is the result of cerebral imperfection, as, occasionally, in idiots, or of some congenital deficiency of that combination of forces which is requisite for so complicated a process. This constitutional impotence is not necessarily associated with any discoverable imperfection in the organs, or any obvious defect in bodily formation. Indeed, it may be associated with full intellectual vigour, and a physique, in other respects, sound and strong. Such cases are, however, rare. The external indications of virility do not often continue when the power is actually and irrecoverably gone.

ATROPHY OF THE TESTICLE

has already been several times alluded to in the preceding pages, with the remark that it does not usually take place although the function of the organ is long suspended, or, even, when it has been lost in consequence of obliteration or destruction of the vas deferens. Neither is it commonly produced by the pressure of hydrocele; although it sometimes is caused by the contraction of lymph effused in chronic hydrocele, or more frequently of the lymph effused in hæmatocele. One of the most common causes of atrophy has been stated to be acute or chronic inflammation—spontaneous, syphilitic, or from mumps—of the glandular substance of the testicle, with effusion of lymph, or pus, into the intertubular tissue; the tubules being compressed and destroyed by the effused products both during their formation and during their subsequent contraction. The same result may follow excessive venery, drinking, self-abuse, or anything which is productive of long-continued depression and disorder of the general health; also injuries of the head, paraplegia, and elephantiasis of the scrotum. Although injury to the duct produces no effect of the kind; yet, as we might expect in the case of an organ so peculiarly circumstanced with regard to its circulation, deriving its blood from a long distance through a single channel, and having very few anastomosing currents to fall back upon, it is very sensitive to any impairment of its vascular supply. Thus Wardrop relates that both testicles were absorbed in a man who died of an aneurism of the aorta, obliterating the spermatic arteries; and ligature of the spermatic artery will cause complete wasting of the gland. Varicocele also is sometimes attended with an impairment of the nutrition of the testis; and operations obliterating the veins in varicocele have been known to produce the same result. The atrophy usually extends more or less to the vas deferens.

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* *Diseases of the Testis*, pp. 63, 364. I have recently seen a case of complete impotence, consequent on a jar to the spine caused by a railway collision.

In elderly persons I have found the testes rather small and flaccid, but in other respects healthy, with sometimes thickening and induration of the epididymis and thickening of the vasa deferentia with opaque white spots in their walls. It has been already observed that the semen usually retains its fecundating qualities. It is possible that the pressure of a hernial pad or bandage may interfere with the functions of the testicle, but it is certain that it very rarely does so.

IRRITABLE AND NEURALGIC TESTICLE.

About the period of puberty the testicle is frequently tender and irritable, so as to be pained by a slight touch or by the chafing of the trousers in walking. It does not swell or present any indications of inflammation, but it is a source of a good deal of annoyance, necessitating confinement from active exercise and out-door amusement. This condition usually subsides in a short time, and may be relieved by a suspensory bandage, or an evaporating lotion if the part be hotter than natural. The same condition may occur at other periods of life, more particularly in persons of delicate, sensitive, and irritable temperament, or in those who have been addicted to self-abuse. It has occasionally proved a very obstinate affection, and has been a source of so much distress to the patient as to lead him to beg for removal of the organ. Sir A. Cooper was induced by the urgent request of the patients to perform castration in three cases of the kind; and other surgeons have done the same. Such a procedure is, however, warranted only by very exceptional circumstances. Usually the malady subsides under attention to the general health. It is necessary to inquire into minute particulars respecting the state of digestion, the action of the liver and bowels, the character of the urine, the action of the skin, &c.; for where there is a tendency to irritable testicle, slight disturbances of other organs will induce it. To rectify anything wrong that may be discovered in these functions is the first point. Secondly, it is necessary to improve the general state of the health by out-of-door exercise as far as possible, by moderately nutritious diet, and, perhaps, tonics. Some good may be effected by local applications, cold sponging, a suspensory bandage, or anodyne applications.

Neuralgia may occur in the testicle from the same causes as in other parts; such as a source of irritation in an adjacent region, a stone, or other disease, in the kidney, ureter, or other part of the urinary apparatus, varicocele, a disordered state of the stomach, liver,* or system; or a depressed condition of the health, especially if that be associated with malarious influence. In the latter case the pain usually comes on periodically. The organ itself may be quite sound.† The pain varies in character and severity, being sometimes dull, at others darting and so severe as to cause the patient to roll on the floor in agony and covered with perspiration.

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* Sir B. Brodie (*Med. Gaz.* vol. xiii. p. 621) mentions the case of a gentleman in whom the neuralgic pains were usually preceded for two or three days by clay-coloured evacuations, pains in the head, &c. In another case there was a small projection of the epididymis: and whenever this particular part was touched he felt a sensation which he compared to that produced on biting on the exposed nerve of a tooth.

† That it is not so always is proved by the case mentioned at page 118, where a small quantity of pus was found in the epididymis. In a case related by Mr. Ludlow, the patient, aged twenty, had neuralgia for six years, originating in an injury. Mr. Stanley excised the testicle; the tunica vaginalis was thickened and adherent, and the epididymis changed into a firm white substance.

The treatment will be the same as for the neuralgia in other parts, varying with the exciting cause and the state of the health. When it is periodic, quinine or iron are likely to be beneficial. Of local measures, the hypodermic injection of a small quantity of strong solution of morphia into the testicle or the tissue immediately investing it, offers the best prospect of success, if we may judge from its effects in relieving neuralgia in other parts.

VARICOCELE.

The disposition of the spermatic veins to enlarge is such as to cause varicocele in about one male adult in ten. It is due to several causes:—to the size and winding course of the veins near the testicle; to their numerous anastomoses, here and in the lower parts of the cord, which interfere with the efficiency of the valves, and enable fluid injected into them to pass readily from above downwards; to the loose inelastic tissue in which they lie affording them little support; and to their passage through the oblique inguinal canal, where they are frequently subjected to pressure during the action of the abdominal muscles; and to the length and comparatively small size of their efferent trunks. The causes usually assigned for the predisposition to varicocele on the left side being so much greater than the right—viz. the slightly lower position of the left testicle, the angle of junction of the left spermatic vein with the renal, and its relation to the sigmoid flexure of the colon—do not seem to me quite sufficient; but I have none other to suggest.

The disease consists simply in an increase of the size and tortuosity of the veins, with a loss of elasticity and contractility, and more or less increase of thickness of their coats; the latter change depending upon an addition of low fibrous tissue, which usually accompanies the enlargement of vessels and the diminution of their elastic and contractile elements. They may be further thickened by chronic inflammation, and the formation of lymph in their coats; and phlebolites are sometimes found in their interior. The degree of enlargement varies much. It may be so great as to fill the scrotum and conceal the gland. This is, however, rare. It is greatest near the testicle, diminishes towards the inguinal canal, and ceases in the canal; so that the spermatic vein at and above the internal ring has its natural size. At least that has been so in the cases I have dissected. The affection is rarely productive of any decidedly injurious effect upon the testicle, or upon the character of its secretion; though, when there is any great dilatation of the veins, the organ is often somewhat smaller than that on the other side; and in a few instances it has been so wasted as to be scarcely distinguishable through the scrotum.

The affection, usually, commences at about eighteen or twenty, and often is not recognised till the swelling attracts attention. It may be induced or aggravated by sudden exertion or straining at stool, by long walking, or standing, or riding.

It is easily known by the feel of the soft worm-like coils of dilated veins near the testicle and extending to a variable point above it. The swelling is inelastic, increases after long standing, and towards the end of the day, and diminishes in the recumbent posture. There may also be a slight impulse on coughing. In these respects, and in its position, it resembles hernia. Still, had I not known a case in which one of the most eminent surgeons in the metropolis made a mistake between the two affections, and persevered in it, I should scarcely have thought it worth while to say a word respecting a difficulty of the diagnosis between the two affections. The feel of the swelling, its slow and incomplete disappearance when the patient lies down, although the inguinal ring is quite free, and its reappearance in the erect posture, although moderate pressure is maintained upon the canal, furnish sufficient means of distinction. The skin is often thin, so that the dark colour and the outline of the dilated veins may be seen through it. The affection is usually devoid of pain and tenderness. Sometimes, especially when it first appears, or when the patient's attention is first directed to it, it is attended with a sense of weight or uneasiness, or it may be actual pain; and it may be tender, and a source of much discomfort. As in the case of varix of the lower limbs, there are times during which, without perhaps any obvious reason, the swelling increases; and at these times there is liable to be more pain than at others.

Treatment.—In the greater number of cases the swelling attains a certain moderate size, and then ceases to increase or to be the source of any pain, inconvenience, or detriment to the organ. It is not usually, therefore, necessary to adopt any treatment, and scarcely worth while even to use a suspensory bandage. The patient may not be conscious of the existence of the varicocele, or will, probably, soon forget it. During the periods in which it is uneasy, painful, or tender, the part should be supported by some kind of bandage, the recumbent posture should be maintained as much as possible, and regular action of the bowels insured. A spirit-lotion applied as in cases of epididymitis, will also give relief. When the discomfort continues, it is necessary to try other means, such as washing with cold water, attention to the general health and state of the bowels, and light clothing about that region. These failing, a portion of the scrotum has been excised in some instances, it is said, with success, but in others with only temporary relief, so that this is scarcely to be recommended. The less severe plan of lessening the scrotal bag by drawing a portion of it through a ring made of soft silver and covered with wash leather, and then preventing its escape by pressing the sides of the ring together,* may be tried; for, if it fails, no harm will have been done.

The best means of affording relief in troublesome and painful cases of varicocele is a well-adjusted truss with the pad upon the external ring. It should press with a moderate amount of force, so as to influence the spermatic veins, diminishing their calibre, and preventing a sudden reflux of blood during exertion and straining, but not so as to affect the artery. The trusses which buckle round the waist, with a pad secured upon the part by means of an under-strap, answer, in some cases, better than the spring trusses, being less liable to displacement. The benefit afforded is often greater than might have been expected. Mr. Curling gives instances in which the varicocele was quite cured after the truss had been worn some months, and in which the testicle, partially atrophied before the treatment began, regained its natural size. In other cases it fails, owing, perhaps, to the difficulty of keeping the pad properly applied.

Various plans for obliterating the veins have been tried, such as compression by forceps fixed on the scrotum, division with the knife in the ordinary way and subcutaneously, ligature by means of needles with thread twisted in figure of 8, and subcutaneous ligature; also ligature and incision combined.

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* Suggested by Mr. Wormald in his lectures, and in *Medical Gazette*, vol. xxii. p. 194.

The incision and the ordinary ligature have been discarded on account of the serious results that occasionally ensued. The best modes appear to be Ricord's subcutaneous ligature,* and the subcutaneous ligature at two points, the veins being subcutaneously divided between them, as effected by Mr. Lee. Each of these measures has led to great relief, or a cure, in several instances; and I do not know that any fatal results have occurred. In some cases no good has followed. It must be borne in mind that all plans for obliterating the veins are liable to be productive of impairment of the nutrition of the testicle; and accordingly, we find that, in some instances, atrophy of the organ has followed the operation. This may have been caused by the inclusion of the spermatic artery in the ligature, an accident that cannot always be avoided, and the liability to it constitutes an objection to the several operations; but the veins are also essential, and if all, or nearly all of them be obliterated, it is clear that new currents must be established, or the circulation, and consequently the nutrition of the organ will be impaired.† For this reason, therefore, an operation should not be hastily undertaken; and another reason for delay is furnished by the fact that the pain and inconveniences resulting from varicocele often, indeed, commonly, subside after a short time, the patient becoming accustomed to and forgetful of his complaint. I need hardly say that an attempt to obliterate the veins is better than castration, which the continued distress has induced some patients to request and some surgeons to perform.*

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* The following description of the operation is given by Mr. Curling: 'The vas deferens being separated from the mass of veins, and the latter being pinched up with a fold of the scrotum, a needle set in a handle with an eye near the point, armed with a double-looped thread, is to be passed beneath them. When the needle has traversed from one side to the other, the loop is to be drawn out, the needle retracted, and the veins let go, the skin alone being now held up. A second needle, similarly armed, is then to be passed through, over the veins, entering at the same hole by which the first needle was thrust out, and emerging at the same hole by which it entered. The second loop is next to be drawn out, and the needle withdrawn. The bundle of veins is thus included between two double threads, of which one passes over and the other beneath it. The ends of the thread on each side are then to be passed into the loop of the other, and now, by drawing these ends in opposite directions, the vessels are tied beneath the skin.' 'The vessels are divided, and the ligatures come away in from the tenth to the twentieth day.'

† Delpech was assassinated by a man whom he had cured of double varicocele by tying the veins some years before. The man's testicles were found wasted and soft after death; the same effect upon the organ has been observed in other cases. The frequent reports of cases of operation for the cure of varicocele induce me to repeat the observation of Sir A. Cooper, that 'varicocele should scarcely receive the title of a disease; for it produces, in the greater number of cases, no pain, no inconvenience, and no diminution of the virile powers.' I cannot but think that operations are sometimes performed rather hastily and unnecessarily for this affection.

TUMOURS IN THE SPERMATIC CORD.

Fatty tumours are occasionally found in the cord, and, like the cysts in the same situation (p. 99), being movable to some extent in the course of the cord, they are with difficulty distinguished from hernia. I found this to be so in the case of a rather stout gentleman who, four years ago, had a swelling, about the size of a walnut, near the external ring. It was doughy, not tense or fluctuating like a cyst, but felt more like a hernia; and it passed a little way in and out of the canal. It could not, however, be returned into the abdomen; was influenced by traction upon the cord; and the finger and thumb could be approximated behind it in such a manner as to prove that it was not continued into the abdomen. I judged, therefore, and another surgeon, who examined it with me, agreed, that it was a fatty tumour of the cord. Since that time not much change has taken place in it.†

Malignant tumours may form in the cord, not only as a sequence of disease of the testicle, but independently of it.‡

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* M. A. Verneuil describes two cases of subcutaneous erectile venous tumours of the scrotum, dependent upon enlargement of the subcutaneous veins of the scrotum, and showing a tendency to spontaneous inflammation. They may be destroyed by cauterisation or extirpation (*Gaz. hebd. de Méd. et Chir.*, Sept. 16, 1859, and Ranking's *Abstract*, xxxi. p. 176). M. Escallier relates two cases of varicose tumour of the scrotum (apparently varicocele more circumscribed than usual), simulating hernia, in which spontaneous inflammation with suppuration took place and proved fatal. *Mém de la Société de Chirurgie de Paris*, vol ii. p. 66.

† In the Museum of the College of Surgeons (No. 2461) is an oval fatty tumour, four inches in length, embedded in the tissues of the spermatic cord an inch above the testicle. In some instances the tumours have closely resembled omentum, and have even, it appears, been contained in a sac like a hernial sac.' Curling, p. 453.

‡ Museum of College of Surgeons, 2462, 3. No. 2367^{20} is described as a large fibro-plastic tumour of the cord.

In the Catalogue of the Museum of Mr. Heaviside is the entry of a 'stone found in the cellular substance of the spermatic cord of a man who died of strangulated hernia.' Gamgee, loc. cit. p. 181.

THE AFFECTIONS OF THE VESICULÆ SEMINALES

have received very little attention from pathologists and surgeons—less than they deserve,—for these bodies are not uncommonly diseased in company with the testicles or independently of them; and such diseases may induce or aggravate inflammation of the bladder, and be productive of other ill effects. It is to be observed that the seminal vesicles lie within range of the finger passed into the rectum; so that their condition may, in most instances, be determined with tolerable certainty.*

They seldom are the subject of spontaneous inflammation, but sometimes become inflamed secondarily, as in gonorrhœa; and the symptoms are much the same as when the prostate is inflamed, viz., uneasiness about the perinæum, pain in defæcation, frequent and rather painful micturition or retention, emissions at night, attended with pain, and the fluid stained with blood. The finger in the rectum discovers the vesicle, on one or both sides, distinctly swollen and tender. In two cases of blennorrhagic orchitis, where the patients died of other disease, M. Goussail found the seminal vesicles swollen and gorged. I do not know of the affection terminating otherwise than in resolution; and I am not acquainted with anything in these parts corresponding with the chronic orchitis, syphilitic or other, of the testicle. They are, however, not unfrequently the seat of scrofulous disease; and in cases of scrofulous affection of the testicles it is well to examine the state of the seminal vesicles; and they will sometimes be found considerably enlarged and firm, from deposit in their canals, although there may be no symptoms of such a condition. The changes that take place correspond precisely with those that occur in the epididymis; that is to say, the tortuous component tubes become enlarged and distended with scrofulous matter, partly infiltrated into the lining membrane, and partly formed of morbid and accumulated epithelium, while the connecting areolar tissue of the tubes remains sound. Subsequently this may be destroyed, if softening and suppuration take place. I have dissected several specimens of this; and some of them are in the pathological Museum of the University of Cambridge.

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* It appears that a thesis has been written on inflammation of the seminal vesicles by M. Eugène Rapin in the *Moniteur des Sc. méd.* 1859, No 42. Canstatt's *Jahresbericht,* 1860, vol. iii. p. 284.

The disease is only to be distinguished by examination with the finger in the rectum; and for want of this exploration it escapes notice in many cases. The organ will be found enlarged, perhaps tender, and more or less firm according to the condition of the morbid deposit in it. The prostate is likely to be the seat of tuberculous disease at the same time. It has been so in the cases that I have dissected. The treatment corresponds with that for scrofulous disease in the testicle and other parts.

I have in several cases known a chronic enlargement of the vesiculæ seminales analogous to the affection of the prostate in elderly persons, and attended with corresponding symptoms of irritation of the bladder. Indeed, I have discovered it when examining the rectum under the impression that there was enlargement of the prostate. What relation, if any, this condition of the vesicles may have had to the bladder-symptoms, I cannot tell. I first found it in dissecting the bladder of an old man who died after long-continued prostatic affection with retention. The prostate was enlarged, and the seminal vesicles were two or three times as large as natural, of very firm structure, so as, in consistence, almost to resemble scirrhus; the component canals were large, and the investing areolar tissue much hypertrophied and indurated. I have now a man above seventy under my care, suffering under severe irritation of the bladder, amounting to incontinence, in whom the prostate is little, if at all, enlarged; but the seminal vesicles may be felt beyond it of twice their natural size and firmer than usual. In other instances I have found on the dissection of the vesiculæ seminales in elderly persons, that the component tubes were dilated, but actually reduced in extent and length, while the connecting and investing areolar tissue was thickened.

Although in the case of imperfect development of the testes at page 73 the seminal vesicles were very small, consisting of few coils of tubes, usually the condition of these bodies shows no especial relation to that of the testes. One testicle may be wanting or imperfectly developed, or the vas deferens may be only partially formed, or have been divided, or become obliterated; yet the vesicula seminalis on that side is commonly as large as on the other side. It is in such case filled with its own secretion unmixed with spermatozoa. This corresponds with what has been said (page 73) respecting the presence of the ejaculatory power in persons whose testes were imperfect or absent.

Affections of the Scrotum.

Œdema.—The loose tissue of the scrotum renders it very liable to œdema, which is often met with in new-born and young children, resulting in them, commonly, from some slight irritation of the skin, and usually subsiding under careful attention to keep the part dry and powdered.* In after life it is easily induced by inflammation or suppuration of adjacent parts, especially abscess connected with the urethra; and sometimes it is the herald of, or attendant upon, general dropsy, resulting from disease of internal organs. It is usually dependent upon some such cause, general or local, and subsides when that cause is removed. Great relief, however, may sometimes be afforded, and sloughing of the part prevented, by punctures with a needle at various points, which allow the serum to drain off, and are rarely followed by any of the ill effects which are likely to ensue if incisions be made.

Inflammation.—Its loose structure and its comparatively isolated pendulous position also render the scrotum an easy prey to inflammation, erysipelatous or other, which is apt to be excited by slight causes, such as small wounds or abrasions, boils or small abscesses in or near it. The inflammation quickly spreads, causing rapid œdema; and, if the patient be in a low state of health, it may go on to diffuse suppuration and sloughing of the skin and subcutaneous tissues. Mr. Liston † described cases of 'rapid distension of the scrotum with serosity' supervening generally upon an abscess or ulcer, perhaps trifling, in the perinæum or groin; and he found that destruction of the cellular tissue and skin could be arrested only by very early and free incisions. Sometimes inflammation is excited by the dribbling of urine; or it may arise without any apparent cause.

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* It is, however, sometimes more troublesome and dangerous. I was called to a case of the kind, in which the inflammation and swelling were very great, like erysipelas, and extended to the penis and adjacent parts, causing retention of urine, and proving fatal in a few days. Two similar cases, also fatal, are given in *Med. Times and Gaz.* vol. xii. p. 364.

† *Medico-Chirurgical Trans.* vol. xxii. p. 288. Mr. Erichsen (*Med. Times and Gaz.* vol. xxi. p. 211) gives a case of acute inflammatory œdema of the scrotum, supervening on a perineal swelling, which first appeared during gonorrhœa, and ending in gangrene. The whole scrotum sloughed, laying bare the testicles.

An abscess rarely forms in the scrotum. When suppuration takes place, it is usually diffuse, and may be recognised by the hard feel and angry appearance of the part, added to the dry tongue and low feverish state of the patient. This result, as well as sloughing, may commonly be averted, where the constitution is sound, by rest in the recumbent position, warm fomentations, and such diet as the condition of the patient requires. If suppuration takes place, or if the discoloration of the skin threatens gangrene, incisions should be made; and it may be necessary to give wine and ammonia to maintain the strength. Under careful treatment the affection, even in severe cases, rarely terminates fatally. After large portions of the scrotum have been destroyed, and the testicles and spermatic cords have been laid bare, granulation and cicatrisation proceed with surprising rapidity, and, owing to the abundance of loose skin, the breach is healed without much detriment.

Though so liable to slough from inflammation excited by a local cause in enfeebled persons, the scrotum is very seldom the seat of mortification from frost-bite. Cases of the kind have, however, been witnessed by Sir A. Cooper and Mr. Curling.

Elephantiasis of the scrotum, so rare in this country,* is very common in tropical climates, especially Bengal, the East and West Indies, Ceylon, Egypt, and South America. It consists in a thickening with some change of structure—a modified hypertrophy—of the skin and other tissues of the scrotum, which are, in addition, infiltrated with serum or oily matter, the latter being sometimes so abundant as to give to the whole the characters of an oleaginous mass. The cremaster has been found thickened, and the spermatic cords elongated; but the testicles are usually healthy. Sometimes there is hydrocele. The disease, which is probably essentially of a low inflammatory nature, commences, in some cases, at one point, and thence spreads gradually over the scrotum; or there may be a tumefaction of the whole bag, which subsides in part, and then returns, and finally becomes permanent and increases. It may be excited by some local cause, such as a fistulous tract; but more commonly there is nothing of the kind. In some cases the part remains smooth; in others it becomes uneven, tuberculated, and corrugated; but in either case it has little or no tendency to ulcerate, unless it be in consequence of abrasion when it has acquired great bulk. It simply goes on increasing, without pain, remaining dry on the surface; and the increase is of a very determined character, no local or general treatment seeming to have much influence on its progress. The mass, in course of time, attains to enormous size, weighing fifty, a hundred, or even a hundred and fifty pounds, and proves fatal by its distressing weight, or perhaps by ulceration and discharge supervening. Several of the patients have been observed to have ichthyosis in other parts of the body.

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* One of the best-marked cases of the tuberculated form of the disease that has occurred in this country is related by Mr. Isaacson in vol. xviii. of *Prov. Med. and Surg. Trans.* p. 244. In the Museum of King's College Hospital is a specimen of elephantiasis of the scrotum removed by Mr. Fergusson from a man who had never been out of this country. The mass weighed 5 lb. 15 oz.: the disease was the result of inflammation consequent on a blow. Cases have also been recorded by Liston, *Operative Surgery*; Brett, *Lancet,* July 11, 1846. Cases occurring in other parts of Europe have been related by Delpech, Lamy, Delmas, Auvert, and Nögell.

In the Museum of the College of Surgeons, No. 2466, is an enormous mass of scrotal elephantiasis, measuring 42 inches in circumference, including the penis and testicles, consisting chiefly of compact structure like mammary gland, and covered with coarse skin, in parts warty and knotty. It was removed by Mr.

Treatment.—In the early stage, especially if the disease assume at all an acute form, it may probably be arrested by measures calculated to allay chronic inflammation of the skin, of which the most important would be pressure. It is, however, by no means certain that such treatment would be effectual; and much time should not be lost in the attempt, otherwise the mass will attain to such dimensions as to render the radical treatment dangerous. Unfortunately, the case is commonly not seen by the surgeon till the period has passed at which curative means are at all likely to be efficient, and removal offers the only prospect of success. This has been done by Mr. Esdaile, in 161 cases, with the loss of only five per cent. When the tumour is of moderate size, therefore, its removal is a matter of little danger; and the testicles and penis may be dissected out and saved. When the mass has attained to great size—more than forty pounds—the hæmorrhage consequent on the division of the vessels feeding so large a mass is frightful; and it is necessary to cut the tumour away as rapidly as possible, without regard to the genital organs; and with all care the patients have in some instances sunk at the time or soon afterwards from loss of blood.*

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* See a case by Mr. H. Walton, *Med. Times and Gaz.* vol. xix. p. 132, in which he tied the scrotum in small segments close to the trunk, removed the

Tumours of the scrotum are rare. Of *cystic* tumours I have met with only two recorded cases.* *Fatty* tumours seem to be rather less uncommon.† Both have proved very difficult of diagnosis. Of *fibrous* tumours several instances have been collected by Mr. Curling; and others have been related. They originate in the areolar tissue, and grow slowly and without pain. Some are very dense, resembling the fibrous tumour of the uterus, and, like it, undergoing occasionally calcification at various parts of the mass; others are more succulent. They may attain to enormous size, weighing twenty, thirty, or more pounds; and have been removed successfully when of this magnitude. Some of the cases have been of the recurrent kind of fibrous or fibroid.‡

We read now and then of large calculi which have formed in the bladder finding their way into the scrotum, and escaping from it by ulceration § or being excised.

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mass below the ligatures; and then, as each strangulated part was liberated, the vessels were secured. The scrotum was eight or nine pounds in weight. The patient recovered.

M. Clot-Bey has given his extensive experience respecting this malady in his *Histoire d'une Tumeur éléphantiaque du Scrotum*, Marseille, 1830; in the *Annales de la Médecine physiologique*, 1834; and in the *Mém. de la Société de Chirurgie de Paris*, vol. iv. p. 547. He regards it as a local affection, distinct from lepra; the principal phenomena being tumefaction, hypertrophy, and inflammation of the skin and subcutaneous tissue; the tuberculous condition of the skin being only an occasional attendant. He believes it incurable, except in quite early stages; and the patient will then rarely submit to the requisite treatment. Extirpation of the part should therefore be practised without delay.

* A transparent cyst, of the size of an apple, containing unctuous yellowish fluid, situated in the cellular tissue of the scrotum, connected with the skin, and supposed to have originated in the sebaceous follicles of the skin, is described by Dr. Bauchet; *Archives gén. de Méd.* 5e. série, vol. ii. p. 71. Mr. Curling describes and represents a cystic mass, like cystic sarcoma of the breast, removed from the scrotum by Mr. Crompton of Manchester.

† *Trans. of Path. Society*, vol. vi. pp. 230 and 232, xvii. 176, and xviii. 186; Curling, *On the Testicle*, p. 490; Kimball, in *Boston Med. and Surg. Journal*, Oct. 17, 1861.

‡ This was so in a case operated on by Mr. Fergusson: a large fibrous tumour was excised from the scrotum; and three years afterwards it recurred, and was of the size of a child's head, involving also the nates. The whole mass was removed. *Med. Times and Gaz.* vol. xiv. p. 166.

§ Auvert (*Selecta Praxis Medico-Chirurgicæ*, vol. ii. tab. cxi.) represents and describes an enormous urinary calculus, which began to form when the patient was ten years old, and ulcerated through the scrotum when he was seventy-one. A urinary calculus, weighing 8 ounces, in the Norwich collection, is said to have been removed from the scrotum. A shoemaker had, for twenty years, a stone in

Cancer of the scrotum is almost always of the epithelial kind,* and usually confined to chimney-sweeps.† It is much more common in this country than in others, but it appears to be on the decrease here—perhaps owing to the more general use of machines for sweeping chimneys. In its origin, structure, course, and implication of adjacent glands, without involving more distant regions, it corresponds with epithelial cancer of the skin in other parts. Thus, it commonly begins in a small soft tubercle or wart on the scrotum, oftenest near the lower and fore part. This tubercle appears to be of simple nature, and may remain for a long time without change, only increasing very slowly. Sooner or later it becomes indurated, spreads, and is covered with a crust;‡ and when the crust is removed it bleeds a little. Subsequently it ulcerates, and an uneven open surface is formed, discharging thin bloody fluid, and having a sinuous edge with a hard tuberated margin and an indurated base. The disease goes on spreading till the whole scrotum is destroyed; and the testicles are exposed and, occasionally, it is said, are involved in the destruction. Before this, however, the inguinal glands usually become indurated. Subsequently they soften and break, forming excavated cancerous ulcers, which spread till the patient is worn out by the discharge and pain. After death the disease is commonly found to be confined to the scrotum and groin, and not to have invaded the lumbar glands or the abdominal viscera.

It seems, then, to be quite a local affection, destroying life by the mere tendency to spread at the part primarily affected,

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the scrotum, which he supported in a pad; at length it got to such a bulk, that, during exertion at stool, it ruptured the scrotum and escaped: it weighed 26 oz. Gräfe, 'Ueber Scrotalsteine,' in *Gräfe und Walther's Journal*, vol. iii. p. 399. Crosse, *On Urinary Calculus*, p. 32.

* A rare case of the growth of medullary cancer in the cellular tissue of the scrotum, involving and requiring the removal of both testes, occurred in the practice of Mr. Craven of Hull; *Med. Times and Gaz.* vol. xix. p. 287. Mr. Curling mentions two cases of carcinoma of the scrotum, and one of melanosis.

† Dr. Warren has never seen it in the United States in chimney-sweepers, but has met with it in a few instances in persons not of that business; *Surg. Obs. on Tumours*, p. 329. In a few cases, in this country, it could not be attributed to the contact of soot. That it may be excited in other parts of the body by soot, is shown by Sir James Earle's case of the gardener who suffered from the disease in the forearm in consequence of his being in the habit of carrying a soot-bag there.

‡ Or by a thick horn-like concretion, as represented by Mr. Ward; *Cases of Disease of the Prepuce and Scrotum*, pl. x. and xi.

and in the glands connected with it; and at first, and, it may be, for a long time, it often has hardly any of the qualities of malignancy. In one case that I remember, the surface of the body generally, and of the inner side of the thighs in particular, was covered with small soft cutaneous tubercles, evidently quite of simple character ; and the cancerous ulceration of the scrotum had, apparently, originated in one of these. Moreover, the ulcerative tendency at the part varies a good deal. In some cases it commences before the mass has attained to the size of a shilling ; in others the whole scrotum becomes converted into a tuberculated or warty mass, with scarcely any ulceration. I had one case of the latter kind in which the disease was of long standing, and too extensive for removal, and which terminated fatally. It has been met with in boyhood, but is usually seen about middle life ; and it has appeared in persons long after they had discontinued the avocation of chimney-sweeping.

Treatment.—The only treatment is extirpation by caustic or the knife; the latter is much to be preferred. The operation is easily performed while the disease is limited to a part of the scrotum, and good hope of ultimate recovery attends it. Still in several cases the disease has returned, sometimes after a long interval, either in the scrotum or the groin. In such case the operation should be again performed; indeed, it may be repeated again and again, even though it be necessary to take away the whole scrotum and both the testicles, if there be fair prospect of removing all the disease. When the glands in the groin are only slightly enlarged they should be left alone; for they may subside or remain quiescent after the exciting cause of their disturbance is gone. If, however, the enlargement is more decided and accompanied with induration, they should be dissected out; and this may be done with very good result; for the disease of the glands is found to be of epithelial character, corresponding with that in the scrotum. In one case in which I dissected out the diseased inguinal glands at the same time that I removed the cancerous ulcer of the scrotum, the patient was well two years afterwards ; in another the disease soon returned and proved fatal. This corresponds with the experience of other surgeons.

AFFECTIONS OF THE PENIS.

By far the larger proportion of these are, directly or indirectly, connected with and dependent upon gonorrhœa and syphilis; and they, as well as phimosis, paraphimosis, and inflammation of the corpora cavernosa, will be found treated of in the following essay.

Priapism.—Erections, too frequent, easily induced, and prolonged, are not an unfrequent attendant on debility, recovery from illness, and other causes which increase general irritability. Sometimes they are an indication of preternatural excitability of the organs induced by exhaustion, or of some irritation of or about the prostate, consequent, perhaps, on gonorrhœa. Priapism, or persistent erection, is a well-known attendant on certain diseases or injuries of the brain or spinal cord. In a few instances it has been caused by extravasation of blood into the cavernous body of the penis from injury during connection.

In a case of this kind, under Mr. Birkett,* where the attendant pain was very severe, some relief was afforded by incisions into the cells of the corpora cavernosa, which gave vent to dark, thick, blood-like fluid; but Mr. Birkett does not recommend the procedure.

Gangrene.—The loose tissue of the organ renders it, like the scrotum, very liable to œdema and inflammation; and its comparative isolation renders it liable also to mortification, which has in several instances been known to occur in the depressed states of typhus. In some of these cases the patients were suffering from gonorrhœa at the commencement of the attack. The penis has also been known to mortify in paraplegia; and a case of spontaneous gangrene occurred, under the care of Mr. Partridge, in King's College Hospital.*

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* *Lancet,* February 16, 1867; other cases of a similar kind are there referred to. A case of persistent priapism in a married man, aged twenty-eight, of rather delicate health and nervous temperament, is related by Dr. J. R. Smith in the *New Orleans Journal of Medicine,* January 1869. Bleeding, tartar emetic, morphia, belladonna, and cold applications were freely tried without effect. After a time, 'the disease gradually and almost imperceptibly gave way.' It does not appear that the bromide of potassium was used. It might be expected to afford relief in such a case; and was found to do so in a case recorded in the July number of the same journal by Dr. Hargis. Fifteen grains of the salt given every two hours produced speedy alleviation of the tension and distress.

For the effects of rupture of the blood-vessels and other injuries occurring during coition and erection, see a paper by Mr. Langston Parker in *British Medical Journal,* May 16, 1868.

Cancer of the penis is most commonly of the epithelial variety, occurs in advancing years, and corresponds in most points with epithelial cancer in other parts of the body. A case of schirrous infiltration of the body of the penis has been recorded by Mr. Coote,† but such an affection is very rare.

It commences usually upon the glans, in the form of a firm warty elevation having a broad base, and slowly increases, for some time, without pain and, probably, without attracting attention. It is at first covered with a more or less thick cuticular crust. This becoming shed, or rubbed off at parts, the growth bleeds a little, and, before long, ulcerates, discharging thin fœtid fluid mingled with blood. In this stage it is usually painful, and advice is, therefore, sought for it. If left alone it continues to spread, destroying the glans, opening the urethra, involving the prepuce, and, finally, extending to the glands of the groin, proves fatal by the irritation and discharges resulting from progressively spreading ulceration. It does not affect distant organs. It now and then begins upon the prepuce. Sometimes the prepuce is in a state of phimosis, perhaps from birth; or it may be ulcerated through, disclosing the growth beneath. Frequently, however, the prepuce is natural, and may be drawn backwards and forwards over the cancer.*

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* 'The man was forty years old, single, and said to be temperate. A week before his admission he was at work as usual, when he became ill, languid, and feeble. He took to his bed and ultimately became delirious. He was kept on low diet all this time. When received into King's College Hospital he looked like a man suffering from low fever. The penis was black and charred-looking nearly down to the scrotum; there was here a line of demarcation, and the urine spirted out at this point. The pulse was feeble and irregular. The penis ultimately dropped off. The parts healed, and the patient went out well.' *Med. Times and Gaz.* vol. xx. p. 277.

The following case of partial strangulation of the penis from constriction is interesting in many respects. A boy was brought to the out-patient room of St. Bartholomew's Hospital with swelling of the penis and loss of sensation, and a fistulous passage communicating with the urethra. Mr. Wormald discrediting the cause assigned (a blow) made a careful examination of the parts under chloroform, and discovered a small string tied round the base of the penis. It appeared that as the penis had swelled the ligature had slowly cut through the skin, nerves, and vessels of the penis; but, as in the operation of linear *écrasement*, the parts healed again as fast as they were cut, and had buried the ligature. *Association Med. Journ.* 56, p. 9

† *Med.-Chir. Trans.* vol.

There is not commonly much difficulty in the diagnosis, partly because the cases do not come under our notice till the character of the disease is well marked. The patient has generally passed the middle period of life. The firmness, or hardness, of the growth, its ulcerating tendency, and the character of the discharge, together with the slow steady progress, leave little doubt of its nature. In the early stages it is not so easy to make the distinction between a cancerous wart, and a common wart, or between a cancerous lump and an indurated chancre which has not ulcerated, or has cicatrised. It is, then, well to give a cautious opinion, and to wait a short time, applying the means which are known to act upon the more simple malady; and it will generally turn out that those means are sufficient—that is to say, the doubtful cases generally prove not to be cancerous.

The only *treatment* is extirpation; and that is best effected with the knife. If the prepuce only be affected, circumcision should be performed.

Circumcision.—The plan which I always adopt is to make a circular incision with a bistoury through the skin on a level with, or a little behind, the corona glandis; then slit up the prepuce to this cut, and with scissors remove it by cutting through the lining membrane a little in front of the incision through the skin. The frænum should be left as long as it conveniently can be. The dorsal arteries, and one or two arteries beneath the urethral orifice, generally require ligature or torsion; and care should be taken to sponge the wound well, and tie or twist such others as bleed at all freely, so as to prevent after trouble. The edges of the skin and the lining membrane may then be brought together with a few points of suture, so that only a linear wound remains. This will sometimes heal in a few days, leaving only a linear scar. It is often not necessary to confine the patient to bed at all, though it is better to do so, or, at any rate, to enjoin rest. I do not apply any lint, plaster, or dressing. These adhere to the part, causing a good deal of distress, and keeping it foul. I simply direct it to be kept dry and clean. It may, after a few days, when suppuration takes place, be necessary to apply a poultice, or water-dressing. I once saw the operation performed with the écraseur. There was no bleeding; but an ulcerating wound remained, which was long in healing.*

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* Mr. Hutchinson relates a case in which fungating epithelial growths spread along the mucous surface of the urethra in a young man; *Path. Trans.* vol. xiii. p. 167. I remember a similar disease in a little girl; I removed the growths, but they returned and proved fatal.

Amputation.—When, as is far more commonly the case, the disease commences on the glans, it may still be possible to remove the affected part without destroying the whole of the glans, or interfering with the urethra. I have done this with good result. It seldom happens, however, that we see the case sufficiently early for this; and it is usually necessary to remove the whole of the glans and more or less of the corpora cavernosa. Before doing this, the prepuce, unless it admits of being retracted, should invariably be laid open, so as to expose the growth, and make quite sure of its real nature. The operation of amputation is usually effected by a single sweep of the knife, the skin having been previously drawn a little forward, to prevent there being a superabundance of it afterwards. A good deal of bleeding ensues, the blood pouring out from the whole divided surface of the corpora cavernosa, as well as from the dorsal arteries. The latter should be tied first; then the larger vessels upon the rest of the stump; and the numerous smaller vessels will close spontaneously after a few minutes. The dread of the bleeding has induced the occasional resort to the écraseur. That, however, is not a sure preventive; for sharp hæmorrhage has followed a few hours after the operation, and it leaves a more sloughy and troublesome wound than the knife.

The stump will granulate and heal spontaneously, the skin closing over the face of it, and becoming puckered to a narrow circle surrounding the urethra orifice. The real, indeed usually the only, difficulty in the operation and subsequent management is caused by the tendency of this circle to contract, more and more, so as to narrow the orifice and interfere with the passage of urine. In a case that I remember, the stricture thus caused led to so much irritation and inflammation of the bladder that the patient, a strong hearty man at the time of the operation, was fairly worn out and died. It is true that in other cases this difficulty has not occurred, although no means have been taken to prevent it. Nevertheless, the liability must always be borne in mind. It may be sufficient to keep a catheter, or other instrument, in the passage. Some patients cannot bear that. To avoid its necessity the following slight addition to the operation has been recommended by Mr. Teale.* 'After the operation of amputation has been performed in the ordinary way, a director is introduced into the urethra, and, by the aid of a bistoury, the urethra and the skin covering it are slit up to the extent of about two-thirds of an inch. A single suture is then placed on each side of the slit, uniting the mucous membrane to the skin. Perfect patency is thus given to the orifice, which is of a long, oval form; and, after cicatrisation is complete, there remains a free opening into the urinary canal, and no mechanical aid is required. The same procedure may be adopted when contraction has occurred during the cicatrisation after amputation, and much trouble and pain will thus be spared.'

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* I quite agree with those who recommend the entire removal of the prepuce in congenital phimosis, having seen the inconveniences resulting from less complete operations. The comparative immunity from syphilis in those who have been circumcised has been shown by Mr. Hutchinson; *Med. Times and Gaz.* December 1, 1855.

I have lately performed the operation in such a manner as to leave the urethral orifice projecting from the end of the stump, and have been well satisfied with the result. I make a circular incision through the skin behind the part to be removed, and reflect the skin for about half an inch, then cut through the spongy body on the level of the first incision, dissect it from the corpus cavernosum to the same extent as the skin, and cut through the corpus cavernosum at this point—that is, half an inch behind the line at which the skin and the corpus spongiosum were divided. Finally, the edges of the reflected skin are united over the stump of the corpus cavernosum by a point or two of suture, the spongy body with its urethral orifice being left projecting a quarter of an inch or more beyond the surface of the wound. It remains slightly projecting, and with a freely open aperture, after the wound has healed.

In cases in which it has been necessary to amputate near the scrotum—a situation in which there is especial tendency to contraction of the urethral orifice—I have, after making a straight cut through the penis in the ordinary manner, carried an incision through the raphé of the scrotum into the perinæum, exposing the corpus spongiosum. I then dissected that body from the corpus cavernosum as far as the crura penis, turned it down into the perinæum, and left it hanging out there half an inch beyond the level of the skin. The cut edges of the scrotum were united by a few points of suture in front of the urethral orifice. The patients recovered quickly, and experienced no difficulty in passing water through the perineal aperture.

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* *Medical Times and Gazette*, vol. xix. p. 354.

When the disease has been completely removed, there is fair prospect of complete cure. I have watched patients remaining for several years in good health. Too many cases, however, have proved the tendency of the disease to manifest itself in the groin after the removal of the penis, if it had not done so before. The affected glands should be removed, if that can be done with safety; the remarks made with regard to the conditions ensuing upon cancer of the scrotum applying to this disease.

GEORGE MURRAY HUMPHRY.

GONORRHŒA.

OF the diseases of the generative organs which, for the most part, take their origin from impure sexual congress, pathology and clinical observation have alike established the existence of three groups, separate and distinct from one another.

I. Gonorrhœa—an inflammation of the mucous membrane of some part of the generative organs, producing muco-purulent discharges. In the male this is frequently attended with an inflammation of the testicle, and in some cases is followed by symptoms referable to the joints and eye.

II. The soft, suppurating, contagious ulcer of the genitals, which differs from the next in the most important characteristic, that it is localised in its sphere of morbid influence, and does not induce general or constitutional infection.

III. That disease which, commencing as a localised affection of some kind, generates those other and more general morbid symptoms denominated constitutional syphilis.

These all agree in the respect that they are contagious, and, however much opinions may differ as to the former, the two last have for their cause a specific virus.

The most frequent disease arising from sexual intercourse is, without doubt, gonorrhœa. This name, although somewhat incongruous—for the prominent symptom of the disease is not a flow of semen, as the derivation of the term indicates, but a muco-purulent or purulent secretion and discharge from the diseased surface—has been so long in use that its abolition would be attended with difficulty.

By some writers the affection is termed 'blennorrhagia.' By the vulgar it is termed the 'clap' in England, and 'chaude-pisse' in France.

There is every reason for believing that this disease has been known from very remote times. The sanitary measures inculcated by the Hebrew lawgiver in the 15th chapter of Leviticus have, in all probability, reference to this disease. It appears likewise to have prevailed among the Greeks and Romans.

Very shortly after the irruption of syphilis into Europe, towards the close of the fifteenth century, a belief in the unity of species and cause of all the contagious diseases of the genitals became widely prevalent. Observers, perceiving that these diseases commonly originated from one source—sexual congress—referred them all to one and the same cause, embracing them alike in the common term of 'venereal.' The confusion and perplexity thus introduced continued to our own day. To the genius and sagacity of Ricord it is undoubtedly due that these almost insuperable difficulties to the right appreciation and study of these diseases have been removed.

Gonorrhœa is an affection of a totally different character to the primary syphilitic ulcer—whether we have regard to its history, pathology, symptoms, terminations and consequences, or its treatment.

Acknowledging all this, as is generally done in these days, there remain a number of well-observed facts which would seem, nevertheless, to militate against it. The writer alludes to those cases in which symptoms of secondary syphilis follow discharges from the urethra, apparently identical with those produced by gonorrhœal inflammation. The explanation usually given is, that when urethral discharges have preceded a syphilitic infection, such discharge has been symptomatic of a chancre within the urethra—chancre larvé—of Ricord. In support of this theory it is alleged—1st, that intra-urethral chancres have been demonstrated in some such cases, and hence probably existed in the remainder; 2ndly, that the inoculation of urethral discharge has been followed, occasionally by the same phenomena as succeed the inoculation of fluids from a chancre; 3rdly, that acquired constitutional syphilis, whenever its course has been observed, has invariably been preceded by some primary lesion of the nature of chancre, and hence that it is in the highest degree probable that the same process may ensue within the urethra, where it is concealed from our sight, as obtains in other parts patent to our observation. It is important to remember that those who deem the foregoing theory unsatisfactory, when applied to *all* cases in which constitutional symptoms have succeeded urethral discharge clinically identical with gonorrhœa, do not at all deny the existence of urethral chancre. They contend that all we can say in these exceptional cases amounts to this—that the existence of chancre has been presumed but not demonstrated; and that from time to time cases of secondary syphilis ensue after discharges from the urethra, in which it has been quite impossible to distinguish the urethral disease from gonorrhœa, and wherein all the evidence at command was strongly against the existence of a chancre concealed within the urethra. Many deny altogether the existence of a chancre deeply seated in the urethra. Vidal, for example, does not admit such, beyond the navicular fossa. The transmission of a virus to a distant part of a canal like the urethra is confessedly difficult of explanation, and it has not been demonstrated to the satisfaction of many pathologists that the two morbid specimens of deep-seated ulceration of the urethra, upon which M. Ricord relies to establish his theory of the chancre larvé, were in reality chancres at all.

The importance of the subject renders it essential that we should endeavour to obtain clear views upon it.

From the time of Swediaur to the present day there has been a well-grounded belief in the existence of a syphilitic blennorrhagia. Hunter, who believed in the identity of gonorrhœa and syphilis, cites the results of his inoculation of pus from a gonorrhœa, which inoculation produced sores having all the characters of chancre, and were followed by symptoms of general infection. The case is related Vol. I. p. 450.

These facts can neither be mistaken nor ignored. Their explanation is well worthy of careful consideration. Two views may be assumed, either of which will yield a probable explanation: first, that the urethral pus was obtained from a concealed syphilitic sore (chancre larvé), alone and unmixed, or mingled with the products of a co-existing gonorrhœa. The second view rests upon the assumption, that not only the fluid products of secondary lesions, but that the blood and fluid excretion from a person constitutionally syphilitic, may produce that disease in a sound person by inoculation.*

It ought not to be forgotten also that the mucous membranes are the frequent seats of the earliest constitutional manifestations, and that a muco-purulent discharge from the urethral membrane is an occasional symptom of secondary syphilitic infection.†

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* See the writer's work on *Practical Pathology* vol. ii 1870; also Viennois, in *Archives gén. de Méd.* June 1860.

† Vide Bassereau, *Affections syphilitiques de la Peau*, p. 356.

Hunter conceived that the pus from a chancre or blennorrhagia applied to a secreting surface (mucous membrane), would invariably produce gonorrhœa; while applied to a non-secreting one, such as the integument, it would equally always develope a chancre.

It is true that this pathology cannot hold its place in the presence of later observations and experience: but there are not wanting a few, though extremely rare, facts corroborative of the truth of Hunter's view of a 'physiological absorption,' *i.e.* the absorption of virus into the blood, without any lesion of the surface to which it is applied.

The bubon d'emblée is an example of this. When we speak of primary infecting sores, we must remember that these do not all alike possess the same objective signs. A primary syphilitic lesion may possess scarcely any induration: and the same may be said of its ulceration or erosion, the amount of which may be barely appreciable. We are ignorant how far the physiological properties of the deeper tissues of the urethra may affect the development in them of specific disease, because of our inability to watch the progress of the disease in the parts.

It has been proved that a purulent fluid, furnished by the female generative organs, can excite a gonorrhœa. Now if such fluid be obtained from a woman constitutionally syphilitic—and uterine discharges are very frequently indeed present in such—there is no reason against its being the vehicle of a syphilitic virus. The primary syphilitic disease will then run its course in the urethra as a part and parcel of the gonorrhœal inflammation, and the limits of any induration which usually accompanies primary syphilitic disease will be lost in the swollen state of the tissues.

Discharges from the urethra and mucous passages of the generative organs may arise from the application of various purulent and irritating secretions to the mucous membrane, or be symptomatic of some constitutional or other disease.

The causes of blennorrhagia will fall under one or other of the following heads:

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syphilised persons is inoculable, their pus is not. He says, that if pus be taken from the urethra of a syphilitic person suffering from gonorrhœa, but whose genital organs are free from syphilitic eruption, and if this pus be inserted in the mucous membrane of another, free from any syphilitic taint—an ordinary gonorrhœa only succeeds: if blood, however, be taken and mixed with the pus, then both gonorrhœa and syphilis may follow.

1. The application of a gonorrhœal discharge to a part of the sexual organs—direct contagion.

2. Certain irritating substances applied to the mucous membranes, *e.g.* menstrual fluid, leucorrhœal discharges, &c.; and other irritants, rather interesting to the pathologist than of any practical value to the surgeon, such as the injection of a solution of ammonia, as in the experiment of Swediaur upon himself.

3. Urethral discharge may arise from constitutional and other causes, irrespective of any contagious influence; as in gouty or rheumatic subjects, and after the use of certain drugs, &c.

Complaints closely resembling gonorrhœa sometimes appear in persons the subjects of stricture or irritable urethra, after sexual intercourse, a debauch, or other excitement.

Occasionally, though very rarely indeed, venereal excitement alone may induce a blennorrhagia of the urethra.

As most people are aware, gonorrhœa is very frequently the result of direct contagion, from intercourse with a person similarly affected. It is needless, therefore to enlarge upon this; but it is of the utmost importance, in a medico-legal sense, to remember that the symptoms of gonorrhœa may be produced by various agents, other than the application of gonorrhœal pus.

It is absolutely certain that gonorrhœa in the male may proceed from intercourse with a woman in whom no morbid changes in the genital organs can be detected upon minute examination with the speculum. Ricord's remarks upon this subject deserve attention. He says:

'If we investigate with the greatest care the exciting causes of gonorrhœa—and I am now speaking of characteristic cases of the disease—we cannot help admitting that a gonorrhœal virus is absent in the majority of cases. Nothing is more common than to find women who have occasioned gonorrhœa unsurpassed in intensity and persistency, and attended by the most serious complications, and who are yet only affected with uterine catarrh, which is sometimes hardly purulent. In many cases, intercourse during the menstrual period appears to be the only cause of the disease; while, in a large number, we can discover nothing, unless, perhaps, errors in diet, fatigue, excessive sexual congress, the use of certain drinks, as beer, or of certain articles of food, as asparagus. Hence the frequent belief of patients, which is very often correct, that they have contracted their gonorrhœa from a perfectly sound woman.

'I am most assuredly familiar with all the sources of error in such investigations, and I will presume to say that no one is more guarded than I am against the various forms of deceit which are strown in the path of the observer; yet I confidently maintain the following proposition: *Gonorrhœa often arises from intercourse with women who themselves have not the disease.* Any one who studies gonorrhœa without preconceived notions, is forced to admit that it often originates from the same causes that give rise to inflammation of other mucous membranes.' *

Diday says emphatically, '*that from the very fact of a woman having a discharge, no matter what its origin, she is liable to give a discharge to a man.*'

Fournier, as the result of his investigations relative to the classes of women from whom gonorrhœa is derived, conceives that gonorrhœa is much less frequently contracted from contagion than from excessive coitus, repeated or prolonged sexual congress, or peculiar excitement during the act.

The opinions of many English surgeons, particularly those of Mr. Skey and Sir Henry Thompson, are to a similar effect, that a gonorrhœa is the product of other causes than a specific poison. Those who oppose this view seem to do so upon the grounds that a gonorrhœa is confessedly a highly contagious disease, and that cases of gonorrhœa so caused differ, in the degree and intensity of the symptoms, from a urethritis excited by other causes.

The truth of the latter statement is somewhat questionable; but, however this may be, it will not affect the question.

The fact of the disease being so commonly caused by impure sexual intercourse is proof of the presence and action of a poison, but only of such a one as is capable of being produced by simple inflammation. A little consideration will serve to remove the obscurity about this subject.

Opinions have been much modified of late concerning the 'specificity' of inflammations. Van Roosbröck's experiments go to prove that an ophthalmia may result from the inoculation of any pus, and that the true morbific property of that fluid depends upon the cells; for when it has been deprived of such by filtration, the remaining liquor appeared innocuous. Mr.

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* *Lettres sur la Syphilis,* 2nd edit. p. 29.

Simon, in his essay upon INFLAMMATION (Vol. I. p. 47), remarks: 'There is ample room to question the popular impression that only specific inflammations are communicable; much reason for suspecting it, on the contrary, to be a generic and essential property of inflammation, that its actions (or some of them) are always in their kind, to some extent, contagious.' Simon quotes from Dr. Guillié's and Sir Patrick M'Gregor's experience upon the occasional contagious properties of infantile and common catarrhal ophthalmia, and cites Dr. Piringer's experiments to the effect that he had succeeded eighty-seven times in exciting conjunctival inflammation by the contact of an inflammatory product (pus), taken from sources the most various.

The experience obtained at some of the London Ophthalmic Institutions is corroborative of the truth of the statement, first made by Van Roosbröck, that as the inflammation, which has produced the pus used for inoculation, has been active and acute, so will the artificial inflammation excited by it be severe in its character.

In this way gonorrhœal pus, applied to the conjunctiva, exhibits far more active properties than pus from most other sources.

It follows from this that the observations of practical surgeons are borne out by modern pathology, and that a gonorrhœal discharge may be the result of other than specific pus.

There is yet another mode of explaining some of those cases in which an individual has contracted a venereal affection from one in whom no disease can be discovered. The doctrine of 'mediate contagion,' as it is called, so long regarded as highly probable, has recently received experimental proof at the hands of M. Cullerier. Although the experiments were made with a syphilitic virus, their bearing upon the subject of gonorrhœa is evident.

> 'Louise Vaudet, aged sixteen, entered the Hospital of Lourcine, ward of St. Mary, No. 9, on October 10, 1848. She bore on each thigh an ulceration with a grey floor and abrupt edges. The disease dated a month. On November 25, after having ascertained beyond a doubt that the mucous membrane of the vulva and vagina was not ulcerated in any part, and that the discharge from these parts was not inoculable, I collected upon a spatula the pus produced by one of the inguinal chancres, and laid it in sufficiently large quantities in the vagina. I made the patient walk up and down during thirty-five minutes, taking care to watch her, so that she might not place her hand on the vulva. After this lapse of time, I placed upon a lancet a certain quantity of the vaginal secretion, and I inoculated with it one of the patient's thighs. I then washed with water the vagina and vulva; I carefully wiped the parts, and then washed them again

with a strong solution of alum. Forty-eight hours after, the puncture of inoculation had produced a characteristic pustule. I left it till next day, so that the experiment might be more certain, and then destroyed it with Vienna caustic. Nothing whatsoever appeared in the vagina; the inflammation was not increased; and after two months the patient quitted the hospital perfectly cured of the vaginitis, as well as of the inguinal ulcerations.

The second experiment was made upon Celestine X—, aged twenty-four, who entered Lourcine, ward of St. Louis, No. 7, on November 28, 1848. She bore on the left thigh an ulcerated bubo of two months' date, and which, according to her, had succeeded a pimple, seated on the internal surface of one of the labiamajora, which had only lasted for a few days. At the time of her admission into the hospital no trace could be discovered of this pimple. The vulva, the vagina, the neck of the uterus, and the anus were all in a perfectly normal state. The aspect of the ulceration on the thighs made me suppose that it was specific. On the day following, the 29th, the pus proceeding from the bubo was placed upon a spatula, and laid in the vagina, care being taken to carry it as high as possible. The patient was then made to walk about for an hour, without knowing that she was the object of an experiment. She was taken back to bed; and I then collected as much as I could of the vaginal mucus, remarking to some pupils and young colleagues who surrounded me, that none of the pus introduced into the vagina could be seen, and that what I had on my lancet was entirely similar to the normal mucus. I inoculated one of the thighs, using the same precautions in washing as I did in the former case. After two days, the characteristic pustule rose, and I only destroyed it after forty-eight hours. The vulva, vagina, and the neck of the uterus were carefully observed during several days, but nothing appeared; the disease restricted itself to the thigh. I must not neglect to say, that although there was no sign of disease in the interior of the organs of generation, yet I made on the same day an inoculation with the mucus with which they were covered, and obtained a negative result.'*

From these observations it results that a female may be the vehicle of disease without being herself affected; and that a virulent pus may be retained in contact with the vaginal tissues for a certain time without producing that diseased action which it is capable of inducing elsewhere.

Seat and progress of the disease.—Gonorrhœa or blennorrhagia is an inflammation, ordinarily acute, of the mucous membrane of the urethra or some other parts of the genito-urinary tract, and accompanied by a muco-purulent or purulent discharge. In the male it comprehends varieties according as it is located in the urethra, upon the prepuce, or glans penis. It may be confined to one of these parts only, or occupy more than one, or all, at the same time.

Gonorrhœa of the nose, mouth, anus, &c. have been described; but the existence of these is open to question, and they are relatively of such rare occurrence that we may, practically, altogether discard them.

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* Condensed from Dr. Cullerier's work, *Des Affections blennorrhagiques*, 1861.

Differences of opinion are entertained as to the exact seat and extent of the disease in the male urethra; some conceiving that it commences exclusively at the fossa navicularis, others at a part more posterior; while Astruc thought that it had its special seat in the various glands and the reservoirs. No doubt some differences will be found to exist in different cases, alike as to the extent of the membrane involved and the acuteness of the inflammatory process.

The ordinary seat, however, of the disease is in the more superficial layers of the mucous membrane, and the inflammation affects the orifices of the follicles and lacunæ in the urethra. It commences, for the most part, at the fossa navicularis and the neighbouring mucous membrane, and, as it advances, spreads backwards, by contiguity and continuity of tissue, to the posterior extremity.

The points at which the inflammation remains most commonly fixed, and in which it is manifested with the greatest intensity, are the fossa navicularis and the vicinity of the bulb. The appearances noticed by Hunter, Sir Astley Cooper, and Ricord, in their dissections were, inflammation of the urethra, without breach of surface; and these appearances were most marked within two inches of the meatus and at the bulb. Although this is an adequate expression of the seat and extent of the inflammation in most cases, with some it is far otherwise.

Gonorrhœal inflammation does not ordinarily affect the whole of the urethral mucous surface, but in some cases, as Wallace remarks, it may be diffused over a wide surface, and 'may involve at the same time the whole of the urethra, the bladder, the testicles, the glans, and prepuce, in the male; and in the female, the nymphæ, clitoris, labia, vagina, &c.; and thus commencing at the preputial end of the penis, in the fossa navicularis, it not unfrequently creeps slowly on to the posterior parts of the urethra, to the bladder, or to the testicles, while it decreases or ceases entirely in the parts first affected.'* It may be confined to the mucous membrane only, or extend to the tissues beneath. Sometimes it would appear that the inflammation is localised to some part of the canal, inducing thickening and effusion into the submucous tissues, and maintaining for a long period a scanty purulent or gleety discharge.

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* Wallace, *Treatise on the Venereal Disease*, pp. 237, 238.

In the chronic stages, the mucous membrane may become granulated like the palpebral portion of the conjunctiva in chronic ophthalmia.

GONORRHŒA IN THE MALE.

Men are much more liable to contract this disease than women.

The first attack is generally the most severe, and a kind of tolerance of the disease is commonly found to follow repeated attacks. The symptoms usually appear from the second to the fifth day after exposure; sometimes, though rarely, at later dates.

The progress of the disease may be conveniently divided into four stages.

I. The symptoms are at first very slight, consisting of an itching or tickling sensation of the meatus; this is found rather more florid than normal, and the lips of the canal are glued together by a small quantity of viscid colourless secretion. This moisture augments in amount, but continues scanty, and passes from the clear watery appearance to one of opalinity. Slight puffiness of the lips of the meatus appears at this time. There is no ardor urinæ at this stage, but only such modifications of sensation as amount to a trifling smarting.

This stage may last from a few hours to two or three days.

The inflammation, such as it is, is both very incipient in degree and limited to the neighbourhood of the meatus and fossa navicularis.

This is the premonitory stage.

II. The symptoms gradually increase in intensity until a highly inflammatory condition is reached. The mucous membrane of the glans is swollen and inflamed, and the entrance of the meatus appears also swollen and florid. Sometimes there is œdema of the prepuce, slight in degree, or sufficient to cause phimosis. The discharge augments rapidly in amount, loses its opaline character of muco-pus, and becomes a thick creamy pus with a tinge of green. The penis and course of the urethra feel tender and swollen to the touch. The slight smarting increases to a severe degree of scalding in passing the urine.

The patient voids it with difficulty in a smaller or forked stream; oftentimes it makes its exit in jerks, alternating with the spasms of the muscles lining the urethra. When the mucous membrane about the bulb is engaged, the patient suffers from pain and weight in the perinæum, which are augmented in voiding his urine.

At night, when the sufferer becomes warm in bed, he is liable to attacks of involuntary erection and chordee. This latter term is applied to that arched or bent position which the penis assumes in erection. The explanation generally given of this phenomenon is this: the urethra, the chief seat of the inflammation, runs along the under surface of the penis. The lymph, which is apt to be effused around this canal, renders it less extensible than that portion of the organ composed of the corpora cavernosa. Hence, in a state of erection, the corpus spongiosum surrounding the urethra, not yielding to the distension, acts like the string of a bow, and chordee is produced. Mr. Milton conceives the mechanism of chordee to be due to spasm of the muscular fibres, described by Mr. Hancock and Professor Kölliker as surrounding the whole course of the urethra.

Abscesses occasionally form in the areolar tissue surrounding the urethra, either anteriorly to the scrotum or in the perinæum. It is not uncommon, also, for one of the lacunæ of the urethra to inflame, suppurate, and form a small abscess (lacunar abscess).

This stage lasts from one to three weeks; the continuance or not of inflammatory phenomena depending very much upon the constitution of the individual, his mode of life, and the number of previous attacks.

The disease, having ascended by a rapid course to a period of maximum severity, gradually subsides and loses its more acute symptoms.

III. This is the stage of decline; the symptoms and discharge having run through the same phases, in an inverse order which they did at the outset of the attack. There is a marked diminution or entire cessation of scalding in passing water; the penis is no longer hot, painful, or tender; the involuntary erections and chordee being absent altogether, or, more commonly, of less frequent occurrence. The discharge slowly diminishes in amount, partaking less and less of the characters of pure pus, and, before disappearing, becoming almost entirely mucous.

This stage is both longer and more uncertain than the preceding ones. It being one of discharge without inflammation or marked complications, it may be readily conceived that either are easily excited and prone to recur.

IV. The last stage does not occur in all cases. It is known by the name of blennorrhœa or gleet, and comprehends a slight but chronic discharge from the urethra, unattended by symptoms of inflammation.

It is impossible accurately to define a line of separation between this and the previous stage, which it generally follows without interval.

A very scanty discharge occurs every morning upon rising from bed, and the lips of the urethra appear gummed together. By pressure, perhaps a small amount of matter can be expelled. The characters of this discharge will vary according as it is the product of a chronic inflammation of some part of the mucous membrane alone, or mixed with the various glandular secretions. Sometimes it is a glairy mucus; sometimes a concreted pus, or a prostatic secretion, or a combination of these. This state is liable to be increased, and attended with irritability of the urethra or bladder, under the aggravation of some such exciting causes as coitus, a debauch, &c.

There are no further symptoms; but the disease is apt to prey upon the patient's mind, and so derange his health and assimilative powers. Haunted by his fears and morbid suggestions as to impotence, he may be deemed fortunate if he escapes the clutches of some advertising charlatan.

Gleet is often the result of an imperfectly-cured gonorrhœa; sometimes it is due to a localised chronic urethritis of the bulb, organic changes within the urethral canal, such as stricture, or mucous vegetations, or it is maintained by an implication of some one or other of the glands in a blennorrhœal inflammation.

From whatever source it arises, it is liable to be kept up by certain bodily conditions, congenital or acquired, such as a general debility or delicacy of constitution; a strumous, rheumatic, or gouty diathesis; or a lymphatic temperament.

Hunter, in his work on *The Venereal Disease*, speaks of gleet as perfectly innocent with respect to infection; and adds that in the relapses, which so frequently occur, the virus, in his opinion does not return. Nothing can be more dangerous than the practice which would follow from such a doctrine. Even if the purely gleety discharge were proved to be innocuous, we know that it is liable to a puriform change upon many and apparently slight exciting causes, and then it would, without doubt, be capable of inducing disease in another. So long as *any discharge exists,* sexual congress is unsafe.

Pathology.—While the gonorrhœal inflammation attacks very commonly the straight part of the urethra, and may indeed go no further, the gleety discharge is more frequently the product of changes going on at a deeper seat—the neighbourhood of the bulb.

Sir H. Thompson remarks: 'Observation demonstrates that the two spots which suffer most from gonorrhœal inflammation are the fossa navicularis and the bulb; I have had opportunities of observing this two or three times in the dead-house, on the bodies of patients who had been suffering from gonorrhœa shortly before death. Unusual vascularity is found in the latter situation, particularly if the affection have been chronic, while the intermediate part appears comparatively very little affected. There is a preparation in the Museum of St. George's Hospital which exhibits the urethra of a patient who died while suffering from gonorrhœa, in which an ulcer exists (the only one to be seen) in the commencement of the membranous portion.' *

A well-marked attack of gonorrhœa in the male may be termed a severe local disease, and rarely terminates in less than three months if no treatment has been applied.

The reaction of the disease upon the system varies very much in different individuals, and in different attacks in the same person. In some cases, a well-marked pyrexial state attends the inflammatory stage of the complaint. Generally, however, there is a comparative if not entire absence of constitutional symptoms. There is certainly a marked tendency to depression of the general health; anæmia is induced, and the sufferer has a pallid and listless appearance of face. These effects will be more markedly evidenced in delicate subjects.

Varieties of the disease.—A variety of gonorrhœa has been described as a 'gonorrhœa sicca.' It must be very rare, and it has not fallen within the observation of the writer. The symptoms would be those of inflammation, such as heat, redness, and swelling of the parts, with scalding in voiding urine and painful erections, but without the discharge which forms so prominent a character of the ordinary form of gonorrhœa.

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* *Stricture of the Urethra,* p. 84.

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Gonorrhœa externa, or balanitis, is an inflammation of the surface of the glans and mucous lining of the prepuce, attended with profuse discharge. It may arise from the same causes as the urethral form, and is particularly apt to occur in persons possessing a long prepuce. A similarly diseased state may be induced by want of cleanliness; a retention and decomposition of the secretion from the preputial glands; and sometimes it occurs as an indication of disordered health.

In severe cases, the prepuce may rapidly inflame and swell, with great pain and febrile symptoms, phimosis being induced. In chronic balanitis with phimosis, it is frequently found, upon exposure of the mucous lining of the prepuce, that it is rough, fleshy, and studded with granular prominences.

Excoriations and erosions of the glans and prepuce are frequently present, and it is of great importance to remember that a balanitis with such erosions may be the precursor of general syphilis.

Upon the glans penis an erosion or rawness is often only a primary sore, and induration of the preputial tissues may appear subsequent to the healing and at the base of the excoriations, so that under such circumstances we must always give a very guarded diagnosis and prognosis.

The treatment of balanitis may be summed up at once: It consists of perfect cleanliness with frequent injections of warm water or an astringent lotion. Lime-water is a good application when there is much inflammation. When there is much discharge without great inflammation, dusting the parts with a mixture of finely-powdered calomel and calcined magnesia is a capital treatment. It can be applied at night, and removed by an astringent wash in the morning.

If the excoriations have not healed in a few days, a solution of nitrate of silver (gr. xx.-ʒj. in the ounce) will generally answer the purpose. A saline aperient and rest are often indicated.

Before passing to the general question of the treatment of the disease, we must briefly notice several complications which may occur.

1. There may be severe irritation or actual inflammation of the urinary organs, sometimes of the deeper portion of the urethra, producing great pain in the perinæum, with spasm of

the external and internal layer of muscles, during micturition. This may cause such pain and difficulty in voiding the urine as to occasionally produce complete retention. Sometimes the bladder is affected, causing a constant desire to make water, and pain in doing so, which lasts for some time afterwards, together with mucous deposits in the urine. Or there may be symptoms of renal irritation, marked by pain in the loins, pyrexia, vomiting, and bloody, albuminous, or purulent urine. This state, with or without symptoms of vesical inflammation, is likely to be induced by strong or untimely injections, absence of rest, alcohol, and the use of large doses of copaiba.

2. Hæmorrhage from the urethra. This is likely to occur during chordee, or violent erections, from rupture of some of the distended vessels. It is rarely large in amount, and exercises a beneficial influence rather than otherwise. In passing, it may be remarked, that the green hue of the urethral discharge is probably due to altered hæmatine being mixed with the pus.

3. Inflammation, leading to suppuration of some of the mucous follicles of the urethra. Sometimes this is confined to a follicle; sometimes an abscess forms both in this and the neighbouring tissues subjacent to the mucous membrane. The swelling thus arising may greatly impede the flow of urine, until it bursts either into the urethra or externally.

4. Inflammation of the lymphatic glands—constituting some form of bubo. Buboes generally make their appearance during the second or inflammatory stage. They are of rare occurrence, except in persons of delicate constitution and lax habit, or when the patient has neglected to rest during the disease. One or more inguinal glands enlarge and become tender, causing uneasiness in the erect position. The areolar tissue and skin around such glands become red and inflamed. If the patient maintains the recumbent posture, and counter-irritation—such as painting the part with a strong solution of iodine, or a blister—be applied, an abscess is generally avoided. In strumous, lymphatic, and debilitated subjects, an abscess will sometimes occur; or one of the glands will become much and chronically enlarged, the superimposed tissues slowly inflame, and abscess with sinuses may follow.

The lymphatics along the dorsum of the penis may be affected also. These vessels may be felt enlarged; but not indurated, as in chancre; the areolar tissue about them inflames, and the skin is generally engorged and red; the pain and tenderness are plainly marked; and sometimes an abscess occurs at the root of the penis. When an involuntary erection occurs, these inflamed lymphatics may prevent the equable expansion of the organ, and give rise to a modified form of chordee.

5. Balanitis has been already alluded to.

6. Phimosis and paraphimosis may likewise ensue.

The terms *phimosis* and *paraphimosis* are applied to two exactly opposite conditions of the penis. In the first it is difficult or impossible to retract the prepuce behind the glans penis so as to uncover it; while in the second the difficulty arises in returning the prepuce so as to cover that part of the organ.

Cases of phimosis are referable to three heads: 1st, congenital; 2nd, accidental, or acquired; 3rd, and not unfrequently, a combination of these two causes, as when some inflammatory disease has attacked the tissues of the prepuce or glans, and so either diminished the calibre of a naturally narrow orifice, or increased the dimensions of the contained part.

The congenital form is very common. In some cases there is not only a narrow orifice to the prepuce, but this is associated with adhesions between the opposed mucous surfaces of the glans and its covering. The majority of cases, however, are dependent upon the narrow orifice only, but there generally exists at the same time a redundancy of preputial tissue.

Although this congenital condition is compatible with perfect health, and may give rise to no obvious inconvenience, still, it is a frequent source of irritation from a retention of the secretions, and must without doubt increase the liability to disease from sexual intercourse.*

Most surgeons have witnessed cases in which, where this congenital formation has not been interfered with, it has given rise to some impediment to the discharge of urine; in a few rare cases this has been so great that the prepuce has become the receptacle for a certain amount of urine; when this condition becomes chronic, the preputial tissues may be much hypertrophied and distended from the retention of urine and the irritation which it sets up. Various and manifold are the symptoms and diseases which have been referred to congenital phimosis. Into these there is no space to enter;

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* See Mr. Hutchinson's interesting statistics upon syphilis as affecting the Jews, *Medical Times and Gazette*, December 1, 1855.

but one may be named as fairly substantiated: it may give rise to atrophy of the glans from impeding its normal growth and development.

Among the evils to which an elongated or adherent prepuce may give rise, there ought to be mentioned vesical irritation, incontinence, or even retention of urine. In young children, prolapsus recti may further complicate the symptoms. The suspicion of calculus, of course, arises in such cases, which are not infrequent in the practice of large hospitals. The removal of the prepuce by circumcision, and the careful separation of the prepuce from the glans penis, will suffice to cure such cases.

Acquired phimosis depends upon some inflammatory or other disease of the prepuce or glans—particularly in those who naturally possess a long and narrow prepuce. Such an inflammation will give rise to swelling of the glans, or thickening or contraction of the prepuce. Of these accidental causes we have, besides balanitis (whether idiopathic or connected with chancres), secondary sores, vegetations, &c., the widely-spread induration of a chancre, and the contraction arising from the cicatrisation of these, more especially when they have been seated upon the margins of the prepuce.

In relation to this subject may be noticed a localised hypertrophy of the preputial tissues as a sequence of chancre of those parts. This consists of an ill-defined, diffused thickening, with or without a small amount of œdema, and is essentially chronic. Of course such a state might induce phimosis.

The treatment will be operative or not, according to the cause and degree of the affection. If the glans can be uncovered, then the habit of doing this, with attention to cleanliness, will often be sufficient. In the congenital form, the operation of circumcision may be at once performed. Such is not the case, however, in the forms depending upon accidental causes. The surface of a wound is then apt to be inoculated with the fluid secretions from those temporary affections which have caused the phimosis. The same caution applies to the application of leeches to the inflamed prepuce. By rest, fomentations, a saline purge, and the repeated injection of tepid or cold astringent lotions, or the remedies necessary for the healing of any ulcer, the inflammatory swelling and, with it, the phimosis disappear; if not, we have recourse to operation.

The operations for phimosis are of two kinds, according as we seek to reduce the length of the prepuce at the same time that we give it a free movement over the glans penis, or as we simply desire to effect the latter object.

Circumcision is the operation required in children, and it is best adapted for adults also when the skin is redundant and the margins of the preputial opening are thickened. Different plans of operating have been devised.* One of the simplest and best is the following:

The prepuce is to be seized with the fingers, or a pair of forceps, at its orifice, and drawn sufficiently forwards, when an assistant grasps and compresses it with a stout pair of forceps immediately in front of the glans. The skin being thus put upon the stretch, it is severed with one stroke of a bistoury immediately in front of the forceps. The mucous lining, which will be found to be still undivided and covering the glans penis, is then to be cut upwards from the orifice, by means of a pair of blunt-pointed scissors, or by a bistoury on a director, and the frænum is to be snipped through if necessary. Any small arteries are to be tied, and the mucous and tegumentary surfaces are to be connected with interrupted sutures, five or six of which will be necessary. If any adhesions exist between the mucous surfaces of the glans and prepuce, these are to be divided, or torn through by stripping the roll of membrane of the latter off the former. In adults circumcision is the best method of proceeding, as it leaves little or none of that disfiguration which is apt to follow the division of the prepuce simply.

When the prepuce is of natural length and appearance, except that the orifice is painfully tight, Sir W. Fergusson recommends, that 'the point of a director should be pushed in front, between the glans and prepuce, about half an inch up, and then a narrow sharp-pointed bistoury should be thrust from within outwards, by which means a wound half an inch in length will be made in the skin. The incision in the mucous membrane will then scarcely appear so long as that in the skin, and it should be lengthened with scissors, and then two, three, or four stitches should be introduced with a fine needle.' It is unnecessary, as well as a cause of deformity, to divide the parts as high as the corona, as some do, for half an inch answers all purposes. Instead of the above plan it has been recommended to make two, three, or four small cuts through the mucous membrane and prepuce at different parts of its edge. This is at least quite as painful, and certainly a less satisfactory method than that described. Sir B. Brodie was in the habit of recommending the division of the prepuce near the frænum; this operation he thought was attended with less subsequent deformity than any other.

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* See the preceding essay, p. 179.

It may be well to add a word or two in the way of caution about these simple operations. 1. Sutures ought always to be employed to bring the parts together, with the view of expediting the process of healing, and preventing the contraction which is apt to ensue when the wound is left to heal by granulation. 2. When circumcision has been performed, the small arteries—particularly any in the neighbourhood of the frænum—should be ligatured at the same time, because these are apt to bleed profusely afterwards, when the patient gets warm in bed, &c., and so consequences very unpleasant to him and the surgeon may ensue. 3. In cases where the phimosis has resulted from disease, and where the prepuce is inflamed, œdematous, or where we have reason to suspect concealed chancres, it is well not to operate, because the wound will very likely be inoculated, and take on an unhealthy action. The phimosis in such cases is to be overcome by local or constitutional treatment. Of course, in some cases the division of the prepuce is essential not only for the discovery and treatment of the diseases which it conceals, but in order to prevent or limit a destruction which may be threatening from the pressure and constriction of the engorged prepuce and the retention of foul discharges beneath it.

The condition known as *paraphimosis* occurs thus: a narrowed and difficultly retracted prepuce, perhaps, is drawn beyond the prominent edge of the corona glandis; in a short time the circulation becomes so impeded by the pressure of the constricting preputial orifice, that tumefaction ensues, with the effusion of serum and lymph, to such an extent as to bury the seat of stricture in a deep furrow. The consequences will then depend upon the tightness of the stricture, its duration, and the amount of inflammatory swelling. Ulceration, or extensive sloughing may ensue, by which the stricture is relieved at the expense of much loss of tissue and horrible pain.

If we look at the penis so affected, we notice that immediately behind the glans there is a prominent roll or collar of mucous membrane, with another, though less prominent, swelling of the integument beyond this, separated, the one from the other, by a narrow line or furrow. It is at the bottom of this furrow that the constricting cause is seated.

This affection is not uncommon in boys.

The treatment will consist in reducing the parts to their normal position without delay. We may apply ice, or direct a stream of cold water upon these so as to constringe them as much as possible.

As the proceeding for reduction is, in most cases, extremely painful, chloroform may be used. The patient is to be placed upon his back: the glans penis is to be well oiled, and covered with a piece of thin rag. With the fingers of the right hand the glans is to be gradually, but firmly, compressed so as to diminish its size: at the same time, with the left hand encircling the body of the penis, the integument is stretched and drawn forwards, while the compressed glans is pushed backwards through the narrow ring.

Should this not succeed—which it generally will—the seat of stricture can be divided by directing a narrow bistoury flatwise beneath it, and then turning the edge upwards; or by cutting through the stricture upon the dorsum of the penis at the bottom of the furrow. It may be necessary to do this in more than one place, and at the same time to evacuate effused fluids by scarifications and punctures.

7. *Chronic inflammation of the prostate* is an occasional result of gonorrhœal or gleety inflammation.

To Mr. Adams's work* the reader is referred for a very full and admirable description of it, as well as to an excellent article by Mr. Ledwich.† See also DISEASES OF THE URINARY ORGANS, Vol. IV. p. 914.

The inflammation is blennorrhœal in type, leading to the discharge of a clear, transparent, or slightly turbid viscid mucus.

This discharge may be sufficient to stain the linen, and is very apt to escape during the act of defæcation. It is *not* semen, as it contains no spermatozoa. The disease gives rise to a sense of weight in the perinæum, symptoms of irritability about the neck of the bladder, a peculiarly exalted sensibility of the prostatic portion of the urethra on passing instruments, and is almost invariably accompanied by physical and mental languor and depression of spirits, sometimes amounting to hypochondriasis.

The treatment will consist mainly in obtaining the patient's confidence, and disabusing his mind of morbid fears as to impotence. Attention to hygiene is important; sea-air and bathing, exercise, the regulation of the bowels by cold-water enemata or an occasional dose of sulphate of magnesia, the use of a full-sized bougie or sound, and the administration of the remedies indicated for gleet—particularly turpentine, the muriated tincture of iron, strychnia, and tinctura lyttæ. If these fail, Lallemand's porte-caustique may be used. The author has found considerable benefit in these cases from touching the prostatic portion of the urethra with dilute solution of the perchloride of iron. This does not give the pain, and is free from some of the other inconveniences attending the use of caustic.

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* *Anatomy and Diseases of the Prostate Gland*, 1853.

† *Dublin Quarterly Medical Journal* for August 1857.

Gonorrhœa is not, ordinarily, attended or followed by any cutaneous diseases. The writer has, however, noticed the appearance of a papular erythema in many cases—not depending upon the administration of balsam of copaiba. The subjects of it were suffering from those dyspeptic symptoms so very commonly present in diseases of the genito-urinary organs, and, in the writer's opinion, the eruption was symptomatic of the gastric disease. It is characterised by dull red or pinkish-yellow spots, of various but medium size, and sensibly elevated above the surface. The colour disappears under pressure of the finger, and slowly reappears upon its removal. Sometimes these spots are mingled with the larger wheals of urticaria. The eruption is rather sudden in its appearance; ordinarily does not last more than a few days, and leaves no copper-staining.

8. *Herpes preputialis* is not an uncommon affection, and requires a few words of comment here, on account of the similarity of its appearance to the incipient forms of primary chancre.

It is known by the appearance of small vesicles upon the internal or external surface of the prepuce.

The disease commences in the form of several red inflamed spots, upon which minute globose vesicles appear. These vesicles are generally arranged in groups or clusters of two, three, or four.

The affection runs the ordinary course of herpes, but the serous fluid, instead of being absorbed, becomes sero-purulent, and (after rupture of the vesicle) desiccates into a thin scaly incrustation, or leaves an extremely superficial erosion. A circle of vesicles sometimes surrounds the orifice of the prepuce, which is then apt to become fissured and abraded. This affection is accompanied by more inflammation when seated upon the mucous membrane than upon the external skin, but rarely lasts longer than four or six days.

According to Dr. Burgess a similar herpetic affection attacks females about the pudendum, appearing upon the external aspect of the vulva or on the mucous membrane internally. This may be mistaken for prurigo.

The diagnosis from incipient chancre—not by any means always easy when the period of observation is very limited—will be determined by the number and appearance of the vesicles, their arrangement in groups, the non-inoculability of their fluids, and their speedy cure by simple remedies, such as sulphate-of-zinc lotion (gr. iij.-iv. to the ounce), with a little lint for protection against friction.

9. *Epididymitis*, or swelled testicle, gonorrhœal rheumatism, and the two forms of ophthalmia—one an acute purulent conjunctivitis; the other an affection of the deeper fibrous textures of the eye, rheumatoid in character, and allied to gonorrhœal rheumatism—are treated of in other essays.

For the sequelæ of gonorrhœa, such as stricture, spermatorrhœa, warts, &c., the reader is referred to the essays on DISEASES OF THE URINARY ORGANS, of the MALE ORGANS, and of the SKIN.

The diagnosis of gonorrhœa is not ordinarily attended with any difficulty. When there is phimosis, the discharge may be furnished from the urethra, or from chancres within the prepuce, or both. We must feel for any localised sore or hardness, examine into the state of the inguinal glands, or wait until, by rest and soothing injections, the prepuce can be retracted.

The diagnosis between gonorrhœa, and a primary syphilitic lesion of the urethra so deeply seated as to be undiscoverable upon forced dilatation of the meatus, is difficult, if not impossible. But it has not as yet been proved that a true Hunterian or infecting chancre ever occurs at so great a depth in the urethra; and the diagnosis between a non-infecting sore and gonorrhœa would not be important.

Treatment of gonorrhœa. First stage. Abortive treatment.—We are met at the outset by a question as to how far this is justifiable. By one party the practice is as loudly vaunted, as by another it is utterly condemned. If truth ever rests in extremes, the latter contains the largest measure of it: but the question really lies between the indiscriminate use and abuse of remedies to this end, and their judicious application in carefully-selected cases. This much may be safely said, that, in practice, it is rare to meet with cases at a sufficiently early stage to justify the use of injections.

When, however, the symptoms are such as have been described and no more, the use of astringent injections will no doubt often abort the progress of the disease.

Considering the severity of gonorrhœa as a disease, its duration, the complications to which it may give rise, and the loss of health and strength which it entails, we are justified in making an attempt to curtail its progress at the commencement.

Spite of the sanction of such names as Carmichael of Dublin and M. Diday, the writer objects to the use of strong solutions as injections, believing them to be incomparably more dangerous and no more efficacious than weaker injections. He is in the habit of using these remedies of a strength and nature as recommended by Mr. Langston Parker (*e.g.* solutions of nitrate of silver gr. j.-ij. to oz. vj.; solutions of sulphate of zinc gr. iv.-viij. to oz. viij., or diacetate of lead gr. xx. to oz. viij.); and, as far as his experience extends, he has seen no cause to regret their application. Unless the injection be properly applied to the diseased surface no good can result; and the surgeon should do this himself at first, and see that the patient is properly instructed in the mode. Glass syringes, properly selected, or hard india-rubber ones, may be used. The patient should have passed his water a short time beforehand, and be directed to avoid doing so directly afterwards. The distance to which the injection is to penetrate may easily be regulated by compressing the canal at the required point. The injection should be used every three or four hours, and the patient seen at least once daily by the surgeon. Mr. Durham has lately invented a syringe, which throws the injection *outward*; a continuous stream may thus be kept up without any danger of the injection passing too far along the urethra. Some surgeons have reported excellent results from these continuous injections, which may also be applied with a common syringe if the urethra be compressed in front of the scrotum. During treatment the patient should be directed to remain recumbent as long as possible, to live upon a farinaceous diet, and to avoid meat, condiments, coffee, and all stimulants, particularly beer. If the bowels have not been already acted upon, it is right to begin with that, and to prescribe an antimonial saline mixture, containing sulphate of magnesia, potassio-tartrate of antimony, and acetate of potass, in sufficient doses to nauseate slightly and relax the bowels without active purging. The patient is better also for drinking plentifully of any diluents of a mucilaginous nature.

The discharge is augmented after the first few hours' use of the injection, and the urine scalds. By about the second day the discharge is perhaps slightly tinged with blood. The injections should then be stopped; but the medicine and precautions as to rest and diet require more than ever to be attended to.

From this period, if the practice is to prove successful, the discharge will diminish, and in about three or four days cease. Should it, however, be diminished, but nevertheless continue, and either no, or very trifling, inflammatory symptoms be present and still limited to the neighbourhood of the meatus, the patient may use a weak solution of sulphate or acetate of zinc. Merely washing out the urethra frequently with tepid or cold water is very useful, inasmuch as the contact of the secretion is by itself a cause for the propagation of the diseased action. If the smarting be such as to render the further use of injections doubtful, these ought at once to be relinquished or replaced by an injection of sub-nitrate of bismuth with a little extract of opium and mucilage. These ingredients act as a local sedative and mild astringent, besides forming a coating to the sensitive mucous membrane.

It is to be distinctly understood, then, that the stage to which these agents are applicable is always a very limited one, and varies somewhat in different cases; that their use presupposes an absence of inflammatory symptoms; an absence of pain in passing water, as well as any such swelling of the lips of the urethra as to cause pain or difficulty in inserting the nozzle of the instrument.

Some persons use at this stage large doses of such anti-blennorrhagics as copaiba or cubebs. This is a practice of which the writer has failed to appreciate the utility, and which he considers dangerous, as in almost every case a good deal of derangement of the digestive system ensues from them, and, not infrequently, symptoms indicative of congestion and irritation of the kidneys.

If, however, any one thinks that he makes 'assurance doubly sure' by their administration, let him use a preparation of cubebs which is comparatively exempt from these liabilities to mischief.

Second, or acute stage.—In the first place, to secure perfect rest in the recumbent posture is most important. In practice, unfortunately, this often cannot be done. All exercise should be avoided as far as possible. The genital organs should be properly supported in a well-fitting suspensory bandage.

The diet should be scrupulously low and unstimulating, as a rule throughout, to which there are no exceptions at the commencement of this stage. The bowels should be well opened, and during the treatment maintained in a relaxed state. Should the inflammatory symptoms be markedly severe, and out of proportion to the amount of discharge, and at the same time attended with much spasm of the urethral muscles, and scalding in voiding urine, the application of six or twelve leeches to the perinæum affords great relief, although their use is not necessary.

The patient should either not wear pieces of lint over the meatus, between the glans and foreskin, or very frequently indeed change these. The contact of lint soaked with pus is apt to induce balanitis and phimosis, if it have not also an injurious effect upon the urethral mucous membrane, by impeding the exit of the discharge.

Of the local applications, none is better nor more soothing than that recommended by Mr. Milton, viz. the application of water, as hot as can be borne, to the genital organs.

The patient should drink frequently barley-water or linseed-tea, to which some mucilage has been added. At this period, saline diuretics, alkaline in character, are almost essential. The writer prefers a mixture of acetate of potass, tincture of hyoscyamus, and nitric ether, to which a small amount of antimony may be added or not. As soon as the scalding in micturition, swelling of the penis, and urgent symptoms are subsiding, the anti-blennorrhagics may be commenced. Their administration, upon the one hand, before the decline of inflammatory symptoms would be most injurious and injudicious; but, upon the other hand, we need not wait until the absence of them in the third stage is pronounced. If the balsam of copaiba be used we need not exceed one drachm doses, three or four times daily; and half that quantity may be used at the commencement.

One of the most useful forms for the administration of copaiba is that in which the balsam is combined with sulphuric acid. Fifteen minims of dilute sulphuric acid may be added to half a drachm of copaiba with some infusion of roses and mucilage. The medicine will act with more certainty in this way, will be better tolerated by the stomach, and will not be so disagreeable to the taste.

The administration of copaiba in any form will occasionally be followed by a rash upon the skin. This often causes the patient great uneasiness, as he fancies that he is affected with secondary symptoms. The rash appears suddenly in small red patches, more or less circular, and somewhat resembling the ordinary nettle-rash in character. It never produces any serious consequences, and generally its appearance is followed by diminution of the discharge and other local symptoms. When this rash makes its appearance the use of the copaiba is usually discontinued, and a saline purgative ordered. If it be desirable to remove the eruption speedily, a warm bath will usually accomplish the purpose.

During the inflammatory stage injections are quite out of the question; but if the scalding be not very great, and the lips of the urethra not much swollen, there is no objection to injecting, with great gentleness, a tepid solution of the extract of opium, or, as directed by Bumstead, this with the addition of glycerine.

The most efficacious plan of treating chordee, when it arises, embraces the following points: to see that the patient has a well-ventilated room, and is as lightly covered with clothes as is consistent with comfort; the avoidance of any supper or drinks for some hours before bedtime, and the use of a hard mattress; to direct the patient, on going to bed, to bathe the parts with very warm water, and to continue to do so until a sensation of faintness is induced, if possible. Of the medicines directed to the prevention of this symptom, the best is camphor in a liquid form, as directed by Mr. Milton (one drachm of the tincture in water before going to bed, and a repetition of the dose every time the patient wakes with chordee). Lupulin may also be given, in ten or fifteen grain doses, before bedtime. It is less likely to disagree with the patient, but is inferior as a remedy to camphor. Perhaps the most efficacious remedy is, however, a suppository containing a grain of opium and three grains of camphor. This may be made with cocoa-nut butter and used every night.

Third stage.—The most important part of the treatment of this stage consists in the use of injections, at the same time that copaiba, cubebs, or other remedies are administered.

Very different opinions have been expressed as to the use of injections. By some it is thought that these are a fruitful source of stricture. A certain amount of truth appears to be present in this opinion; for of the soldiers treated in Her Majesty's army-hospitals, but few suffer from stricture; while among officers, who use injections to a far greater extent, stricture is not infrequent. This is only apparent, however; for a structural change in the urethral tunics is the result of some preceding inflammatory process; and the more chronic such morbid process has been, the more likely it is that stricture will result. So far as injections are curative of inflammation, so far will they tend to prevent its occurrence. When by injudicious use they have aggravated or maintained the existing disease, or when they have produced a temporary freedom from discharge, and the patient has been deceived, on this very account, into believing himself cured and has acted accordingly, no doubt they may so far tend to the production of stricture.

The writer firmly believes that, when used with ordinary care and judgment, injections are among the very best and most reliable agents we possess for the cure of gonorrhœa.

It is to the third stage of the disease that they are particularly applicable; and the following affords a sketch of the writer's plan of treatment of that stage.

The urgency of the inflammatory symptoms passed, but the entire absence of such symptoms not pronounced, the patient should commence with an injection of bismuth and mucilage (bismuth subnitr. xx. gr. to j. oz.), to which a little morphia, extract of opium, or belladonna, has been added. This may be injected thrice daily, and the patient be directed to cleanse the urethra also by an occasional injection of cold water. After a few days, this injection is to be exchanged for one of sulphate of zinc (j. gr. to j. oz.), and the strength of this gradually increased to iv. grs. to j. oz. If the patient has progressed to a certain extent with this, but then remains stationary, a variety of injections may be tried, inasmuch as change in itself appears useful. The chloride-of-zinc injection, as recommended by the late Mr. Lloyd, is an excellent one (j.–ij. grs. to iv. oz.). The injection so long in use at the old Lock Hospital, of sulphate of zinc and acetate of lead xxx. grs. of each to vj. oz., is a very good one. Alum and vegetable astringents are of inferior efficacy. The writer does not commonly use nitrate of silver as an injection; but if others have been tried, a weak solution (j.–ij. grs. to j. oz.) may be employed.

Recently the sulpho-carbolate of zinc, in the proportion of two or three grains to an ounce of distilled water, has been used, and has proved very efficacious.

The next most important local measure is the occasional use of bougies. The bougies may, before being introduced, be covered by different kinds of ointment or by the balsam of copaiba. The writer much prefers the wax or the metallic pliable instruments for this purpose. An instrument should be selected of sufficient size to adapt itself to the urethra without distending it; and such a one should be passed (with the utmost gentleness) twice or thrice weekly. The writer has obtained excellent results from this combined plan of treatment.

If scalding be present, the bougies should not be used at all; if their introduction induces spasm, the attempt must be made at a later date, or the instrument may be left, as far as it has passed, in the hands of the patient for a few minutes, when it can probably be carried on, without pain, by the most trifling pressure.

As regards medicines, the administration of copaiba or cubebs in some form appears well adapted to this stage.

As stated by Ricord, both copaiba and cubebs seem to undergo some changes in the digestive process which are essential to the development of their curative properties, for injections of these agents are comparatively useless.

It is in the elimination of these agents by the renal organs that they are brought in contact with the urethra and effect a cure.

This was proved by a case in Ricord's practice. A man, the subject of gonorrhœa, had a fistulous opening in front of the scrotum, communicating with the urethra, through which his urine passed. He could, however, close this opening and direct the stream over it through the usual outlet. Copaiba was administered to this patient, and he was directed to pass his urine through the fistula. In the course of a few days the 'running' from this part was cured, that from the anterior portion of the urethra remaining. By passing his urine through the whole canal, the anterior portion was also cured.

The writer has frequently appealed to the experience of the patients themselves as to the effect of different remedies; and the result of his inquiries and personal experience has led him to think that, upon the whole, a treatment embracing the use of anti-blennorrhagic remedies—such as copaiba and cubebs, singly or combined—will be found to yield the best results.

The beneficial effects of these remedies may have been overrated, but experience confirms their influence upon the disease.

The mistakes that are made with reference to the administration of copaiba are chiefly two—viz. the use of the remedy when it manifestly disagrees with, and is not tolerated by, the system; and its continuance beyond a certain time where no benefit has accrued from its use. If the patient's digestion be much deranged by the balsam, then copaiba may be prescribed in some other form,—in the shape of pills mixed with magnesia, or enveloped with a coating of gelatine (capsules as they are termed). A few days will generally suffice to indicate whether the patient can take the remedy. If his system revolts against it, only disgust and injury to health can ensue from its continuance. Cubebs will generally be found to agree and answer well in such cases. The dose of the powder is a drachm thrice daily. Another error consists in the continuance of copaiba or cubebs, without benefit, after about a fortnight. Nothing is more certain than that none will result from their further use under such circumstances.

Sometimes a combination of cubebs and copaiba will be found to agree with, and benefit the patient. The diet during this stage may be of a good plain description, without stimulants, unless specially indicated. The more the patient continues in the open air—provided this be without much walking—the better; and the daily use of a tepid or cold sponge-bath, and friction with hair-gloves afterwards, are useful.

As the health will almost surely have been impaired by the amount of discharge, loss of exercise, &c., it is almost essential that some preparations of steel be administered towards the close of the case. Such can be combined with cubebs, or given separately. The writer finds a combination of strychnia and iron to be an admirable one. It creates appetite, improves the digestion, and tends to keep the bowels regular, rather than confined.

Certain obstacles to success will be met with in different cases. These may be classed under two heads:—1st, local causes. Sometimes the use of injections appears injurious. The patient suffers from pain along the urethra, irritability of the bladder, and sense of weight in the perinæum. Injections must then be discontinued; an alkaline diuretic, with hyoscyamus, and an occasional warm bath being substituted for them. After waiting for a short time, other attempts may be made with injections of a weaker kind; and here the use of bismuth is indicated. Sometimes the use of injections in any form is injurious. The irritation caused by frequently inserting an instrument within the meatus; the contact of an astringent with the mucous membrane; and the direction of the patient's attention to his disease,—may all tend to protract the disorder or exaggerate the importance of otherwise trivial symptoms. The presence of stricture, or obstruction of any kind, may have to be determined and overcome by appropriate treatment. Sometimes the discharge is kept up by a congested state of the prostatic part of the urethra, and a blenorrhagia of that and neighbouring glands. The treatment will best consist of—Canadian turpentine in ten-grain doses two or three times daily; the passage of a metallic sound greased with a little oxide-of-zinc ointment (one dr. to one oz. of lard); and the use of strychnia and iron. In some cases, where the antiphlogistic treatment and regimen have been carefully attended to, the inflammatory symptoms are of unusual duration, and appear to be unaffected by remedies. This is particularly observed in clear complexioned persons, or those of sanguine or lymphatic temperaments. In such cases we must adopt an expectant plan of treatment. We may give pil. saponis c. opio night and morning; iodide of iron with sarsaparilla; endeavour to establish a copious diuresis by making the patient drink a tumbler of cold water three to five times daily; use injections of opium or belladonna in glycerine; and let the patient enjoy as much sunshine and fresh air as practicable.

The obstacles to success arising from constitutional causes, are debilitated states of system, engendered by the disease itself, too much medication, low living, and absence of air and exercise; as well as those congenital or acquired states of system which place the patient in the same category.

Too much importance cannot well be given to our efforts for raising the standard of health by every means in our power. How often it happens that a patient's recovery is protracted from over-medication in every way! Change of air and scene; sea-bathing; a tonic regimen (including a glass or two of good port, madeira, or claret); tonic medicines, particularly preparations of iron—alike establish the general health and cure the local disease.

Blisters have been highly recommended by many, particularly by Mr. Milton; but the writer's experience has not led him to form a high opinion of their efficacy. One caution is worthy of remark, on account of the frequency with which the inquiry is made—smoking is injurious. The writer instituted a few comparative observations upon this subject, and he found, and the patients themselves found, that smoking affected the disease injuriously.

Fourth stage. Gleet.—We must remember that this condition is very apt to be due to errors of constitution, such as the strumous, rheumatic, or gouty diathesis, and modify our treatment accordingly. The remarks made in regard to the constitutional remedies in the third stage will apply with more force perhaps to this. The further use of anti-blenorrhagics is needless and hurtful; while the administration of salts of iron is generally indicated. A combination of the tinct. ferri muriatis with tinct. lyttæ is very good. A return to accustomed exercise in the open air is to be made. So that the patient avoids fatigue and riding, he cannot be too much out of doors. Sea-bathing is generally beneficial. We must endeavour to discover what requires amendment or improvement in the system, and act accordingly. Each case will present a physiognomy of its own. It is necessary to bear in mind the tendency which exists to a return of inflammation, or an implication of other organs, as the bladder, upon the recurrence of exciting causes.

Among the local agents which may be employed with benefit, two are of especial value—viz. the occasional introduction of a bougie, and injections, of which the sulphate, acetate, or chloride of zinc are the best. The writer thinks also that the application of a small blister to the perinæum is a useful measure, particularly if the blistered surface be kept open by the use of an irritating ointment.

GONORRHŒA IN THE FEMALE.

Gonorrhœa is a much less common affection in women than in men; and when it does occur, the disease is ordinarily much less severe, and hence more rarely comes under treatment.

A consideration of the very different parts and structures, and the different physiological functions of the female generative organs compared with those of the male, will at once suggest differences in the course and symptoms of this disease in the female. While the urethral mucous membrane is the ordinary seat of gonorrhœa in the male sex, the vagina and vulva are commonly affected in the female. In the male again, gonorrhœa is the result generally of contagion; in the female, vaginal and uterine inflammation and discharges are very common from other causes, and it is impossible to say how many cases in them are the result of contagion, or to diagnose between a discharge the product of gonorrhœal inflammation, or one from other causes. Dr. West says, 'The microscope fails to furnish us with a means of distinguishing between gonorrhœal and simple vaginitis, and no symptom or combination of symptoms is absolutely conclusive on this point.' It is imperative upon us to remember that vaginitis with purulent discharges is common enough in children and young females, from various constitutional and local causes, because such symptoms often give rise to perfectly unfounded charges.

Gonorrhœa in the female comprehends varieties, as it is seated in the vagina, vulva, urethra, or uterus.

In the vagina it commences as an inflammation of the mucous membrane, with heat, redness, swelling, and tenderness; and is attended with a secretion at first of muco-pus, afterwards of true pus. Any part of the canal may be affected, particularly the anterior wall beneath the pubal arch; or the whole lining membrane may be involved.

In the vulva the earliest symptoms are, sensations of heat and pruritus; to this a dry and swollen state of the mucous membrane of the vulva and nymphæ succeeds. This stage is very short, and a copious purulent offensive secretion appears. The tumefied state of the parts renders their separation very painful. The various muciparous and sebaceous follicles of the vulva become involved, and pour out a copious secretion. The vulvo-vaginal glands, known as Duverney's or Cowper's glands, situated upon either side of the entrance to the vagina, become engaged, and besides the copious secretion these may yield, they may become the seat of abscess. Mr. Salmon has called attention to cases in which these glands are alone affected. The swollen nymphæ often protrude beyond the labia.

The uterine form is commonly the result of the spreading of the inflammation from the vagina. The canal of the cervix is the part usually engaged. The os uteri is red and patulous, hot, and tender. By pressure a very tenacious muco-purulent discharge exudes. Erosions and patches of excoriation are commonly present about the os and outer aspect of the cervix.

Gonorrhœa of the urethra very rarely exists alone, but is found in common with one or other of the foregoing affections. The meatus is congested, and the canal swollen and tender; some discharge may be made to exude by pressure applied to the under surface of the urethra against the os pubis, provided the patient has not passed urine shortly beforehand. Scalding is commonly present. The symptoms are less acute than in the male, owing to the shortness and want of complexity of the female urethra; the disease also is less protracted, and does not ordinarily pass into gleet.

Complications.—Inflammation of the inguinal glands from gonorrhœa in the female is rare, and almost limited to cases in which the urethra is affected.

Vegetations and mucous patches are not at all uncommon.

Sometimes it has happened that a vaginitis has induced inflammation in the Fallopian tubes as well as in the cavity of the uterus. West mentions two successive attacks of vaginitis at an interval of eighteen months in the same patient, which were followed by such severe peritonitis as to call on each occasion for the abstraction of blood.

Ovarian inflammation, corresponding to the epididymitis of the male, occasionally occurs. It has been described by Hunter, Dr. Tilt, and others. It is marked by pain, swelling, heat and tenderness on pressure in one or other of the iliac fossæ. There is generally pyrexia; sometimes much nausea; and movements of the abdominal muscles are painful. The treatment of this complication will consist in rest in the horizontal posture; the application of leeches to the tender part, followed by fomentations, and the exhibition of saline medicines with opiates to relieve the pain.

Gonorrhœal rheumatism is rarely, if ever, met with in females; and gonorrhœal ophthalmia appears to be uncommon also.

The treatment will vary to a certain extent, according to the age and character of the patient, the sthenic or other type of the symptoms, and the stage.

In the acute stage perfect rest, salines, low diet, emollient sedative solutions, and strict attention to cleanliness, are required. Leeches are not advisable, as the bites are apt to be inoculated by contact with the discharges—inflammation and troublesome sores sometimes ensuing. As the disease begins to subside, astringent injections may be used; a weak solution of acetate of lead, or the liquor aluminis compositus largely diluted with water. Sometimes a weak solution of nitrate of silver is very beneficial. These injections should be used four or five times daily, in large quantities, and properly applied by means of one of Kennedy's elastic bottles. Pieces of lint steeped in the lotion may also be inserted so as to prevent contact and friction of the apposed surfaces. The exhibition of specifics (copaiba and cubebs) in the gonorrhœa of women is perfectly futile, unless the urethra be affected, and even then they seem to be productive of little, if any, benefit.

As soon as the inflammatory symptoms have subsided, the same injections may be used as have been recommended in cases of gonorrhœa occurring in men, and they may often be used four or five times the strength.

HENRY LEE.

DISEASES OF THE BREAST.

THE surgeon who desires to discriminate accurately between the different diseases of the breast, and wishes to assist the efforts of nature in their cure, must never be unmindful of the physiological peculiarities of that organ, and the important function which it performs in the animal economy. Closely associated through the medium of the nervous system with the pelvic procreative organs, the breasts are intimately combined with them in the performance of their healthy functions, and are not less peculiarly sensitive to, and speedily influenced by, their morbid states.

Hence it is necessary to preface this essay with a few general remarks: 1st, on the anatomy of the gland at different periods of life, and under precise physiological conditions; for the brevity of which the required limitation as regards space must be pleaded as an excuse: 2dly, we shall refer to some of the more important points in relation to the diagnosis of the diseases: and lastly, to their treatment.

GENERAL OBSERVATIONS.

Anatomy.—Unlike most organs of the body, this gland maintains a perfectly rudimentary state for several years after birth, until, like the others belonging to the functions of procreation, its development advances sympathetically and synchronously with the ovaries and uterus, at a certain definite climacteric, termed the age of puberty. Even in both the sexes changes in this organ then take place. In the male, after slight temporary excitement, the action subsides, and a state of repose is maintained by it throughout the remainder of life, with rare exceptions. But in the female the rudimentary organ of the infant and of the child becomes developed into a gland at puberty, when a state of passive maturity only is attained. Still further changes are excited by the stimulus of conception, to convert it into the source of nourishment for the offspring; when, in this its most perfect state, it becomes an active organ, a secreting gland. Yet this is but a transient condition. For in the healthy state of the organ, it continues only as long as the stimulus to the activity of its function is applied; it immediately ceases when that is removed. It now resumes a state of repose, to be, nevertheless, excited to a repetition of its function as the stimulus arises. When, however, the demand for its functional activity is withheld, or the period of life is reached when the functions of the procreative organs become extinct, this gland also becomes wasted, and the process expressed by the term 'involution' takes place, or, in other words, atrophy occurs. It must be likewise remembered, that at every catamenial period more or less temporary sympathetic actions are excited in this organ.

In the human subject the normal number of the breasts is two. Deviations from this very rarely occur, but one or both may be absent (*amazia*); and cases of plurality, or excess of the usual number (*pleiomazia*), are recorded. The breasts are placed on the antero-lateral regions of the thorax, and occupy more or less superficial extent in different individuals. Hence they are termed pectoral. They are interposed between the integument with the subcutaneous fat and the great pectoral muscles, beneath the inferior and axillary border of which a portion of the glandular tissue often extends. They are held in their position by fibrous bands, which extend from the integuments to the fascia of the pectoral muscle, between the separate masses of glandular tissue; these are the suspensory ligaments of Sir A. Cooper.

Examples are recorded in which glands secreting milk, supplementary to the normal breasts, have existed on the thorax, in the axilla, on the back, the abdomen, and in the groin. The shape of the breast varies considerably at different ages, under its changeable functional states, and in different individuals, in relation to their peculiarities of nutrition. Considered as a mass of glandular tissue, the shape of the whole body is hemispherical, the convex surface being in immediate relation with the integuments. The whole organ is constituted of a variable number of individual masses, each one having its separate excretory duct or lactiferous tube. These are again and again divisible into the lobes and the terminal lobules, in which are observed the acini, composed of the cæcal terminations of the ducts. The lactiferous tubes commence in these cæci, and the minute ducts unite and unite until a single canal is formed, which, after dilating before it reaches the nipple (the reservoir of Sir A. Cooper, or sinus lacteus), terminates in an open mouth thereupon. Every acinus, lobule, and separate lobe possesses a delicate fibrous envelope, and all are united together by means of the ordinary connective tissue which abounds in this organ. That segment of the breast nearest to the axillary and abdominal regions of the body is the largest. The fossa or sinus between the breasts is called the bosom. The *nipple* is that division of the gland to which all the ducts converge, which projects upon its surface, and is surrounded by a dark circle of skin called the *areola.* It is composed of a large quantity of contractile fibre-tissue, as well as connective, through which the milk-tubes pass to terminate in open mouths upon its apex, between the superficial rugæ of its cutis. Beneath the skin of the areola numerous sebaceous glands are usually distinctly visible, but not constantly.

The mammary organ undergoes great changes at different periods of life. In infancy, it is but rudimentary, and although it enlarges and even secretes milk a few days after birth, it is not until the age of puberty that the glandular tissue is really developed in any quantity. At this time remarkable structural changes occur, and in a few months the growth of the organ is complete. But even then it is only perfect to a certain point. After puberty we therefore recognise two conditions: a state of inactivity or repose, passive maturity; and a condition in which the function of the gland is actively performed, when milk is secreted. At a subsequent period the tissue of the gland generally becomes atrophied, and fat occupies the place of the gland-tissue. The ducts, however, are persistent. Associated with these different states there are certain diseases requiring to be specially noticed. It therefore behoves the surgeon to take cognisance of them in all cases of disease, the nature of which he may be required to discover.

Whilst investigating the development and structure of the breast, it is essential to bear in mind the two parts into which every secreting gland is divisible; that is to say, those structures within which the secretion is formed, and the tubes along which it flows away; or, in other words, the secreting portion of the organ, and the excretory ducts. The progressive development of this gland takes place very slowly, and is intimately associated with certain definite periods in the life of the female. We shall therefore describe its condition at birth and before puberty; at puberty and subsequent to that period; after uterine conception, after parturition, and during lactation.*

1. *Anatomy and diseases of the rudimentary organ at birth and before puberty.*—Before birth, soon afterwards, and to the age of pubescence, the glandular element consists of the excretory ducts only, in a more or less rudimentary state, imbedded in a fibrous stroma. In their earliest condition they are not even tubular, but solid, and are composed of an aggregation of nucleated cells terminating in clavate ends. Each duct radiates from the nipple towards the periphery, by gemmation becomes more and more branched, and, by slow degrees, a tube. Before birth the nipple is represented by a slight depression. Here we may observe that in many of the *adenoid growths*, to be hereafter described, the structures resembling those above mentioned are seen, and they are probably identical. Also that this rudimentary state of the nipple sometimes remains persistent throughout life. Soon after birth, in both sexes, the rudimentary organ becomes swollen and tender, at which time a little secretion sometimes escapes from the nipple, which, of course, is extremely minute. A well-marked hardness may be felt, which, when pressed, causes pain. By the officious interference of nurses, this excited organ is often inflamed when they use rough and frequent frictions to 'rub away the milk.' If this rudimentary organ be examined after death at this moment, it shows remarkable vascular congestion.†

2. *At puberty*, and especially after the appearance of the catamenia, the secreting portion of the organ becomes developed.

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* The reader, desirous to peruse a more detailed and minute description of the physiological anatomy of the breast-gland than the writer is permitted to introduce into this essay on its diseases, may refer to *The Anatomy of the Breast*, by Sir Astley Cooper, 1840; *Ueber d. Bau u. d. Entwicklung d. Milchdrüse bei beiden Geschlechtern*, von Dr. Carl Langer, Wien, 1851; *Mikroskopische Anat., oder Gewebelehre d. Menschen*, von Dr. A. Kölliker, b. ii. p. 467, 1854; or the translation of Kölliker's *Manual of Histology*, published by the Sydenham Society, vol. ii. p. 272. Also an article entitled 'Pathologische Anat. d. Brustdrüse, von Dr. H. Meckel,' in the *Illustrirte Med. Zeitung*, von G. Rübner, b. i. 1852, p. 141. Stricker, *Handb. d. Lehre v. d. Geweben*, Leipzig, 1870.

† On the secretion of milk in new-born infants, see an interesting paper by Natalis Guillot, read before the Academy of Sciences in Paris in October 1853; or a translation in *Edinb. Monthly Jour. of Med. Science*, February 1854.

This consists of the cæci or true terminal gland-vesicles, which are first perfected at the borders of the gland only, causing when touched a sensation as of minute granules subcutaneously seated. These terminal vesicles are formed of a structureless membrane. They are connected with the terminal branches of the ducts, and are externally covered by a network of capillaries. Their contents are oval and flattened nucleated cells. The breast having reached a state of passive maturity does not appear to be divided into individual masses, and the surface of its section is therefore perfectly smooth, homogeneous, and of an opaque yellowish white tint. But a gland by which milk has been once secreted shows the separate masses of which it is composed much more distinctly, as the connective tissue unites them together less firmly. The ducts in the peripheral portions of the gland are always in a more advanced state of development than those in the centre, in the virgin as well as in the puerpera. The stroma of the breast consists of fibre-tissue in large proportions. It is chiefly filamentous and wavy; but intermixed with it is that variety so abundantly met with in the contractile membranes. Doubtless this tissue preserves the form of the organ, as well as assists in compression of the milk-tubes. Besides these tissues we see a well-defined fascia or membrane investing the most minute divisions of the gland-structure, its lobules and lobes. A double outline is thus produced bounding the cæci.

In the adenoid growths developed in the breasts of girls and young maidens, we meet with structures identical with those above described. Many of those tumours are, indeed, absolutely extra growths of the tissues composing the breast, and in some instances of even single and married women, the new growth attains to the perfection of the normal gland and secretes milk.*

At puberty the development of the breast advances rapidly in healthy girls. In males it is often attended with pain, which lasts but a few days, and then subsides. Occasionally, however, the region becomes much swelled, the integuments around the areola pink or red, with a conical prominence of the nipple and enlargement of the areolar sebaceous glands. When this excited action has somewhat subsided, a little serous discharge sometimes oozes out of the ducts on the nipple. Usually youths take little notice of these changes; but now and then, either from alarm at the occurrence, or from pain attending the pressure of the dress or manipulation of the part, the advice of the surgeon is asked. The age of the patient in whom the complaint occurs is the best aid in diagnosis. The removal of every cause of irritation, the application of moisture, if the part be red, enjoining repose, and attention to the general health, suffice to remedy the trouble. Should abscess occur, it must be treated *secundum artem.* Permanent enlargement of this gland is sometimes met with in delicate men, either on one or both sides. It is termed *gynœcomazia.*

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* See cases in *Guy's Hospital Reports*, 1855, Adenocele, case 1, with a lithograph, and case 2. Since the publication of those cases, the writer has met with others.

In the female the progressive development of the gland generally advances in both breasts simultaneously, unassociated with local or constitutional disturbance. On the other hand, some girls show the anomaly of unsymmetrical development, that is, one breast enlarges and reaches a considerable size before the other makes any advance towards development. The age at which this strange defect takes place, concomitant with other phenomena of girlhood life, should guide the surgeon to a correct diagnostication of its nature. After reassuring the patient and her friends, the rest may be left to nature. Usually the commencement of mammary development precedes the first catamenial period; and if the breasts should sympathise with any morbid state of the ovarian functions, suitable medical treatment is indicated. It is a matter of considerable importance that, in order to favour the healthy development of the breast, the pressure of the dress against the growing organ should be studiously avoided.

The nipple and areola.—The nipple is composed of the ducts united together by connective tissue, with blood-vessels, lymphatics, and nerves. These are all covered by skin, upon the surface of which, and beneath the cuticle, lies a layer of pigment cells. To this the colour of the organ, as well as that of the areola, is due. The shade of brown varies from a light to a darker hue, according to the complexion of the individual and the active or passive state of the gland itself. The connective tissue contains a large quantity of the contractile fibre, which when excited to contract by any local irritation, or even mental emotion, produces a rigidity of the whole organ, which has been termed erection. There is not, however, a trace of true erectile tissue to be seen in it; the capillary blood-vessels are numerous and looped, and they may become congested; the milk-tubes may likewise be turgid and distended, as occurs during lactation; but the prominence and rigidity of the nipple, occurring in the virgin or married woman, is really only attributable to the existence of the contractile tissue, a layer of which exists also beneath the cutis of the nipple and areola, and produces the peculiar corrugation of that dark circle of integument. If looked for, it will be seen that the *cutis anserina* of the surrounding integument usually accompanies the condition of the nipple above alluded to. Covered by the skin of the areola are the lacteal sinuses. Here the ducts dilate before entering the nipple. Within that organ they are again contracted, and where they traverse the cutis each tube is extremely fine. Their open mouths are protected between the rugæ of the cutis; for the terminal boundary of the nipple is somewhat flattened and rugous. In these furrows small ulcers are frequently formed, and the secretions of the minute follicular glands and of the ducts, when allowed to accumulate, cause considerable irritation and inconvenience. The contractile fibres in the apex of the nipple may subserve the important purpose of preventing the constant flow and escape of the milk from the ducts. The validity of this statement can be tested by examining the nipple when its ducts are distended and the outlines visible near its root or beneath the areola. But as soon as the warmth of the infant's mouth induces a relaxed state of these fibres, the mouths of the ducts are no longer compressed, and the milk flows freely.

The glands of the areola.—Within the area of the areola are situated hair follicles and sebaceous glands; the latter are often arranged with considerable regularity, especially a circle of them, smaller than the others, near its periphery. The large sebaceous glands elevate the delicate cutis of the areola, beneath which there is always an absence of fat. Hence sebaceous tumours are occasionally developed in this region. Hairs are rarely developed, except as age advances, or as correlative with a somewhat masculine development, or tendency to hairiness generally.

The nipple also becomes somewhat further developed at puberty in the female. It forms with the areola a conical elevation of the skin, having a bluish or pinkish tint; but it does not project much until a later period of life, often never at all in unmarried women. The size of this organ varies exceedingly in prolific women as well as in sterile; for, even in those who have suckled large families, its size often bears no proportion to the use made of it. In shape, too, it is very variable. Sometimes it is bifid at the extremity, and even two nipples have been seen on one breast. Anomalies in number and position occur in both sexes. But the most serious deformities affecting this organ are those where the development of its projection is arrested and it continues flat; or when, worse still, a depression or hollow only exists, in which the milk-tubes terminate. Very rarely, a duct opens on the areola, not as the result of disease, but as a congenital imperfection.

Cases of precocious development of the breasts are recorded.*

3. *After the complete establishment of puberty; after uterine conception; after parturition, and during lactation.*—The only normal changes in the female breast which occur irrespective of conception are slight enlargement, attended with more or less pain, according to the susceptibilities of individuals, at each catamenial period, and a slight change in form and consistence soon after congression with the other sex. The nipple, areola, and its glands, show great changes, as respects form and colour, under these circumstances, as well as after much handling and uterine conception; but it would be foreign to our purpose to enlarge upon them.

The changes of most importance affecting this organ are excited by conception. Now it is that its peculiar function to secrete food for the nourishment of the offspring is about to be performed; and from month to month, simultaneously with the development of the fœtus, alterations in the condition of the breast are observable. These changes are most easily watched in women having small glands; for in such the secreting portion of the organ would seem to disappear almost entirely after the cessation of lactation; whilst in those whose breasts remain permanently large throughout life the structural changes are not so easily detected. Nor does the size of the organ bear any just proportion to the perfect performance of its function; for, as a rule, large breasts do not secrete so freely as small ones; and generally, when the milk is abundant, it is very poor in its nutritious qualities. Neither are its dimensions always but it is more common during the former period than the latter. And, when developed at weaning, it is usually excited by an accidental circumstance, *e.g.* the death of the infant, or illness of the mother, necessitating the abrupt discontinuance of suckling. In the majority of instances it is secondary to local irritation, especially ulceration of the nipple, obstruction of a milk-duct, or a contusion; and, as an occasional source, we must notice a diseased state of the axillary lymphatic glands. Having stated that it arises, first, in the inactive stage of the organ, and secondly, at periods of its functional activity, we may next describe its effects in relation to those different conditions.

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* *London Journal of Medicine*, vol. i. p. 85; *Gaz. Méd. de Paris*, 1834, p. 881.

During infancy.—Soon after birth, in both sexes, although most commonly in the male, the mammilla frequently becomes swollen and painful, the skin around slightly pink, and there may be a serous fluid, or even milk, secreted, which oozes from the ducts. Nurses who indulge the propensity to interfere with the processes of nature, by 'rubbing away the milk,' too often excite inflammation, which is indicated by the usual local and constitutional signs, and sometimes passes on to suppuration. Even eight days after birth this rudimentary organ occasionally causes much pain from slight inflammation becoming developed around it, which cannot be assigned to manual interference. And in a female infant, three months old, we have seen an abscess in this region, the exciting cause of which it was not possible to discover, except it was constitutional delicacy. The mother of this infant stated that, unlike others, there was not in this one any secretion in the breasts after birth, and that, consequently, the usual means 'to rub away the milk' were not employed. We need scarcely say that, as a prophylactic measure, every cause of irritation must be carefully removed from the excited organ; even the friction of the dress against it should be prevented in delicate infants. With a tendency to inflammation, warmth and moisture may be maintained over the affected part by using the softest application, such as moist cotton-wool, or some medicated lotion may be advantageously employed, *e.g.* liq. plumb. diacet. dilutus.

At puberty.—Associated with the development of the breast in the female, inflammation very rarely occurs, although the gland often becomes exceedingly painful, and the nipple and areola of a deeper red. But after puberty, when the organ is developed but inactive, both acute and chronic inflammation arise; for which it is often difficult to assign a cause. Chronic abscess is certainly more common than acute. This disease occurs in delicate strumous girls; it usually commences as a hard, painless, defined swelling, with sometimes slight uneasiness. In this stage it may be easily mistaken for a new growth, until, as the tumefaction enlarges, it becomes softer and softer, and fluctuation is detected. Then it is supposed to be a cyst, as very little pain has been felt, and constitutional disturbance has not been excited. At last the swelling is punctured and the pus escapes. In this way the discovery of the contents of the cyst is frequently made, and all doubt as to the nature of the complaint is removed. Cases of this kind deceive even the most experienced surgeons. Operators, acknowledged to be the greatest adepts at diagnosis, have proceeded so far even as to commence an operation for the removal of a new growth from the breast, which proved to be but a chronic abscess; and therefore the careful surgeon should always suspect the existence of a chronic abscess until there be most unequivocal indications that the disease is of another kind. In cases of this class the disease appears to depend chiefly upon some constitutional defect, and therefore the rule as regards treatment is to improve the general health. It would be idle to enter at great length into the treatment of this malady. Bearing in mind the anatomical disposition of the organ, and its relation to the surrounding structures, it demands no very special mode of treatment. We may therefore pass on to that kind of inflammation and abscess so commonly developed in the breast at the time it is an active secreting organ, or preparing to become one.

During pregnancy and lactation.—Inflammation rarely occurs whilst the breast passes through those phases which render it a secreting organ. At this time it is often very painful, and there may be slight vascular excitement; but inflammation is not developed unless some injury chance to be inflicted by sudden violence or continued compression exerted by the clothes.

It is, however, very common during lactation. Generally it happens with primiparæ; and, in a majority of cases, it is determined by either a defective development of the nipple or a morbid state of it. It most frequently arises during the first month after childbirth.

The examination of 149 cases of inflammation ending in abscess showed that in only 17 women the disease was not associated with lactation; whilst in the majority, 132, it arose in those who were suckling. In 118 cases, either inflammation or abscess occurred in more than half of those who had given birth to a first or second child, and nearly one-third were primiparæ. An inspection of the nipple showed that in 97 cases of abscess this important part of the gland was imperfectly developed in 48, and diseased in 19, whilst it was well-formed and healthy in 30. Thus we find half the cases associated with defective nipple; and adding to these the patients with unhealthy nipples, we have more than two-thirds of the cases of inflammation and its results complicated with, and probably excited by, malformations or diseases of the aggregation of the excretory ducts constituting that organ. As to the period after parturition when inflammation occurs, I found, in 116 cases, that it commenced during the first month after parturition in half of them, viz. 58 cases, and in a large proportion of these during the first week. In the other 58 cases, commencing after the first month, in 11 it began during the second month, in 8 during the third, in 22 between the third and eleventh, and in 17 between that month and the twenty-first. Now, as very few mothers continue to suckle for so long a time, it would seem that abscess depends very commonly upon protracted lactation, and probably the constitutional exhaustion excited thereby.

The above facts teach the following lessons, which, if fully accepted in that light, may prove of great importance, and save much misery. They should induce the surgeon to anticipate the probable result concurrent with the conditions described, and they furnish a substantial basis upon which to propose prophylactic measures in order to avert the ill consequences arising from them. Thus it behoves the medical attendant upon a primipara to examine carefully the condition of the nipples; and if there be any imperfection, to employ means to excite their development, or, at least, to prevent the gland-tissue from becoming so gorged with milk as to conduce to subsequent mischief. Occasionally diminishing the distension by removing small quantities of milk with a breast-pump will prevent lactic congestion, the forerunner of inflammation and its results. Also, it often happens, when the gland-tissue is much congested, that the orifices of the ducts in the nipple are more than usually inverted, and that relatively with a more empty state of the whole organ the nipple becomes more prominent. The opening of one or more of the ducts is sometimes obstructed by an accumulation of epithelium, which is indicated, according to Dr. Ratzenbeck of Prague, by a very minute white projecting translucent vesicle. The milk-congestion of that lobe, the duct of which is thus blocked up, may be relieved by the withdrawal of the cause producing it.

Semeiology and progress of inflammation.—The earliest deviation from a healthy state of the gland is usually indicatedby more or less induration, which involves one or more of its lobes. Slight uneasiness in the act of lactation, or during the movements of the arm, often leads to its discovery, for in this stage (the first) the pain is not acute. Occasionally, patients state that a sensation of chilliness, or a shivering fit, preceded the discovery of the 'lump, knot, or coring of the milk,' as it is commonly called. In this stage, the secreting portion of the affected lobe is simply congested with milk, and especially the more solid portions of that secretion. The skin over the induration is not affected, and gentle manipulation of the part is tolerated without inconvenience. With very variable rapidity, in different cases, the induration increases; more and more of the lobes are affected, until at last the whole organ becomes involved in the disease. This constitutes lactic congestion. It sometimes takes place with but slight inconvenience, caused at least by pain, and without exciting much constitutional disturbance. In other cases, the disease advances rapidly; the skin becomes red, swollen, and even œdematous, usually over the primary induration; great suffering is caused, and severe constitutional excitement aroused. As time passes on, the length of which cannot be fixed with any uniformity, suppuration takes place, and the pus collects either in the breast, behind it, or upon its cutaneous surface.

Hence the division of mammary abscesses into three classes: superficial or super-mammary, intra-glandular, and sub-mammary. Each kind is characterised by a peculiar train of symptoms and very marked local indications, which we must now describe.

The superficial abscess, bounded by the cutaneous surface of the gland behind and the integuments in front, generally pursues a rapid course, and is not attended with very severe constitutional disturbance. In very cachectic women, however, the action is not limited; but it extends along the connective tissue around the whole gland, destroying it, and causing diffused suppuration, and, in rare cases, a wide-spread destruction of the skin. But in those superficial collections of pus, that fluid quickly makes its way towards the integuments, by the natural process termed 'pointing,' and the contents of the abscess escape. The usual local and constitutional symptoms accompany the morbid action, which it would be idle to describe here. (See INFLAMMATION, vol. i.)

Intra-glandular abscess, the result of inflammation affecting one or several of the component masses of gland-tissue, is attended by local and constitutional symptoms of much greater severity than the variety last described. The pus collects within the fascia of the organ. The local pain is often agonising; the rigid texture of the gland-tissue, yielding slowly, compresses the inflamed structures, and the intense throbbing, burning heat, and heavy weight complained of produce sufferings with difficulty mitigated. The integuments slowly participate in the morbid action, and the whole breast sometimes becomes double the normal size before either redness or swelling takes place on the surface. At last, however, at a spot usually over the site of the primary hardness and most painful point, the integuments yield slightly to pressure, where there may be also slight redness and œdema. From this the superficial inflammation extends, and, in a few hours afterwards, fluctuation of pus is felt. The constitutional symptoms are usually severe. After the first forty-eight hours from the discovery of the first hard spot, acute pyrexia is frequently developed, and accompanied sometimes with cerebral disturbance and excitement.

Sub-mammary abscess is characterised by the remarkable appearance of the whole organ. The breast seems to rest upon, or to be pushed forward by, something developed behind it; and, when slight pressure is used with the whole hand in a direction towards the thorax, the part feels as if it were resting upon an air-cushion or something elastic. This disease is generally slow in its progress; the local pain attending its development is commonly not so severe as in that last described, the redness of the integuments covering the breast is very slow to appear, and the nipple is often remarkably free from all disturbance. Constitutional reaction is not often excited until a somewhat late period; scarcely at all in some patients, until the fascia or the integuments, or perhaps the gland itself, become involved. The progress of the pus through the integuments is slow, and very often pointing takes place at several spots around the periphery of the gland; or the pus makes its way between the lobular masses of the organ, and an opening forms near the areola towards its sterno-clavicular border, that part of the gland being the thinnest.

The treatment of inflammation must be conducted upon general principles; for those which are applicable in like conditions of other tissues of the body should be the guides for the administration of remedies when that disease affects the breast. However, a marked peculiarity of the organ affected arises from the fact that it is an active secreting gland in a majority of the cases; and the disease is often developed soon after childbirth, and therefore intimately associated with the puerperal state. In these circumstances, then, we have additional elements which require attention.

When merely a part of the gland is indurated and painful, without redness of the skin, a careful examination of the nipple should be made with the view to detect any obstruction of a duct or irritation about the orifice of one. Should the gland become much congested, mechanical means must be employed to remove the milk. Suckling need not be abandoned; but care must be taken that the gland tissue is really fairly emptied of its secretion. The application of an evaporating lotion, or of one containing liquor plumbi, made warm before using it, frequently gives relief. The arm of the affected side ought not to be actively used; and a bandage should be adjusted in such a manner as to prevent the weight of the breast dragging upon the affected part. If the patient lie in bed, the breast may be supported on her chest, or a pillow may be arranged between the arm and affected side, upon which it may rest—a method which, in some cases, is more agreeable than a bandage. Careful attention must be given to the condition of the alimentary canal, and a gentle aperient is often beneficial.

As soon as the skin becomes red, the local application of warmth and moisture is indicated. This principle may be carried out in many ways, the details of which it would be idle to relate here. The abstraction of blood, by means of leeches, may be useful at this stage; they should be made to bite at the periphery of the breast, nearest to the site of the inflammation, in preference to the part where the redness exists. The quantity of blood drawn must be regulated by the state of the general health of the patient, which commonly requires supporting rather than depressing. Nevertheless, in strong healthy young mothers, where the difficulty arises from deformity of the nipple, active local and constitutional measures are quite justifiable, and are frequently attended with great benefit. At the bedside, the practitioner has in fact, first, to establish clearly the cause of the inflammation; secondly, to consider carefully the constitutional condition of the patient; and the treatment of the case must be regulated by the indications afforded. One word of caution in reference to lowering the reparative powers of the patient. We believe that the practice is often carried too far, and that much greater advantage is gained by giving support at the time inflammation exists, not alone with the view to its resolution, but prospectively upon the chance of suppuration taking place. Cases of acute inflammation of the breast during lactation, have been successfully treated by covering the whole organ with collodion.

Abscess; how it is to be opened, when, and where.—The question is often asked, Is it advisable to open the abscess artificially, or leave the pus to escape by natural efforts alone? Should the pus be superficial, the local action circumscribed, pointing advancing without threatening destruction of much skin, and the constitutional disturbance trivial, the contents of the abscess may be allowed to escape by the processes of nature. But if the skin turns purple beyond perhaps an inch, and the cuticle peels off for a wider extent, the introduction of a lancet at the centre of the purple spot becomes necessary to prevent further extension of the mischief and gangrene of a large area of the cutis. The opening in an abscess of this kind should be free; a mere puncture will not suffice. It should be sufficiently large to allow the pus to escape readily; pressure to hasten its exit must be studiously avoided, that the walls of the abscess may collapse naturally; and the breast should be carefully supported with a bandage.

Abscess confined within the fascial envelope of the breast and between its component masses should not be interfered with too soon, unless the constitutional disturbance excited by the retained pus in its efforts to make its way to the surface be uncommonly severe. When, however, the skin becomes red and œdematous, a spot, softer and more yielding than the surrounding parts, may be generally detected. Very commonly this is discovered over the site of the primary hardness. Now, if the local pain be severe, the constitutional disturbance excessive, and the patient much exhausted by the tedious progress of the complaint, the introduction of a bistoury at the soft spot before mentioned affords almost instantaneous relief by diminishing the tension of the inflamed tissues, which was induced by the pressure of the fluid.

In cases of sub-mammary abscess the pus makes its way to the surface very slowly; the constitutional symptoms are not generally so severe as in the last-described variety; and it is in most cases desirable to seek the spot, from time to time, at which nature is effecting an opening for the escape of the pus. This most commonly happens somewhere around the periphery of the gland; rarely the pus burrows through it, in which case pointing takes place over that part of the breast where the gland-tissue is thinnest, *e.g.* in the quarter between the nipple and the sterno-clavicular articulation. In order that the pus may escape most freely, an opening at the lower border of the gland is considered preferable to one in any other part; but it may be as well to state that in this kind of abscess the disease is seldom cured after making one opening only. These are the cases in which numerous apertures are often formed; fistulæ and sinuses, traversing in several directions, burrow behind the gland and between its compact masses, producing an amount of suffering, and depression of the system generally, very difficult to obviate. When the pus points, ordinary rules suffice to guide the surgeon in the treatment of the case.

Other methods of emptying abscesses are employed by surgeons. Some prefer to remove the pus by means of a trocar and canula, making at the same time a somewhat valvular puncture; and when all the pus has flowed, the sac is washed out with tepid water. The canula is then removed, and the whole organ strapped up in order to keep the walls of the abscess in contact. This method is reported as successful in effecting that which may be termed the primary cure of abscess. Others, after emptying chronic abscesses, inject solutions of iodine; and a vulcanised india-rubber drainage-tube, introduced into the cavity of the abscess, is said to hasten cicatrisation. These methods of treatment are not, however, generally available in acute abscesses, but may be employed in those of slow formation and unconnected with lactation.

Treatment after an abscess is open.—For a few days it may be well, in some cases, to apply warmth and moisture to the surface of the breast generally; but we have not found any advantage to be gained by encouraging suppuration, as the long continuance of poulticing usually does. On the contrary, we prefer to cover the opening lightly with a small piece of wet lint or cotton-wool, over which very thin gutta-percha is laid, to prevent rapid evaporation, immediately after the flow of pus has ceased; and then to support the part carefully with a suitable bandage. The diet of the patient should be nourishing, not too stimulating, although there is no objection, if the patient be low, to allow some mild stimulant to be taken. Under similar conditions, tonics must be likewise administered.

Consecutive abscesses not unfrequently occur. This circumstance usually happens in those instances of general congestion of the whole organ before described. As a sequela of abscesses, sinuses sometimes remain a long time, being very difficult to heal. Stimulating injections, strapping up the breast with plaster, and applying a bandage methodically (p. 235), and, as a last resource, cutting them open,—are means towards effecting cicatrisation.

Milk fistulæ will not usually heal until the secretion of the gland is arrested.

Chronic induration of the gland-tissue may affect the whole of the gland, or only portions of it. The degree of hardness thus produced is sometimes sufficient to excite the alarm of the patient and the anxiety of the surgeon. A minute examination of the gland-structure thus diseased shows that those tissues of the organ in which secretion takes place, that is to say, the cæcal terminations of the ducts, are the parts principally involved in the morbid action. During the inactive condition of the breast, when its tissues are soft and yielding, although somewhat firm to the touch, the cæcal terminations of the ducts are scarcely recognisable in the field of the microscope. Here and there, perhaps, a trace of them may be discovered by small accumulations of epithelium. But when the breast-tissue is indurated, the cæcal terminations of the ducts are gorged with epithelium, the acini become perfectly distinct, and a somewhat excited state of the organ seems to be the cause of the development.

This morbid state is seen in breasts of all shapes and sizes; the large, heavy, pendulous variety is thus affected as well as the small, atrophied, disc-shaped organ. When manipulating the first variety, the gland seems to be distinctly circumscribed, and it feels just like a great ball under the integuments; in the last, the fingers may be insinuated beneath its borders, and the whole mass feels like a quoit covered with skin. When a single mass of gland-tissue is affected, or perhaps two or three neighbouring masses together, or in different parts of the same organ, the indurations resemble tumours formed by a new growth, and they are frequently mistaken for adenoceles or cancer. The induration is most distinctly felt when it is pressed between the finger and thumb, or the breast is grasped from side to side and raised from the pectoral muscle. When pressed flatly against the chest, it is imperceptible as a hard mass. In most cases complaint is made of severe pain, and in some nervous excitable women the suffering occasioned is described as agonising. The slightest touch is scarcely endurable, and any pressure upon the induration produces an immediate outcry of distress, of which the countenance of the patient is also an index. The cheeks are often suffused with a bright-red blush as well as the throat and neck, although occasionally the effect of the sudden pain is to produce the very opposite result, when the cheeks become pallid, the pulse small, and a sensation of faintness, nausea, and even syncope may occur. But the pain is not confined to the affected breast. Patients complain of its wide-spread distribution, and some state that it shoots up the neck, others behind to the back and especially the blade-bone, and often down the arm. The surgeon too will discover that the slightest pressure over the intercostal foramina, whence the mammary gland nerves escape from the chest, either the middle or anterior branches, induces acute pain, and that sometimes even a single branch is alone affected, whilst all the rest are not. And it may be observed that the filaments of the painful branch are distributed to the indurated part of the breast. The pain is commonly paroxysmal, lasting various periods of time, and recurring without any assignable cause. It will sometimes even cease to be felt in the breast first affected and pass to the other; again change; and thus alternate from side to side. There is not a trace of inflammation in the integuments. The breasts of unmarried women between twenty-five and forty years of age are most commonly affected; and of the married, sterile women are much more subject to this affection than prolific. General functional disturbance of the generative organs usually accompanies this state of the breast, sometimes indeed precedes it. The opposite derangements—amenorrhœa, menorrhagia, dysmenorrhœa, and commonly profuse leucorrhœa—are the manifestations.

The general health is also much disturbed, the rest broken, and the nervous system highly excited.

The diagnostication is aided by the history of the case; *i.e.* by the age of the patient, her social condition, constitutional health, and functional derangement of the generative organs. Manipulation, methodically employed, also assists materially. If the nervous filaments be sought for and pressed upon, the pain induced is almost pathognomonic of the disease. When the hand is passed gently over the gland, nothing indicating the existence of a new growth is felt, which always happens when one exists; the induration is very distinct if compressed between the fingers and thumb, but imperceptible with the hand flatly placed upon the part.

The constitutional treatment consists in the employment of every measure calculated to improve the bodily health: thus, mild aperients, alteratives, various kinds of tonics, the mineral acids, iron, quinine, and in some cases sedatives, exert a very beneficial influence. As a topical application, the liquor plumbi diacetatis dil., an evaporating lotion, or even one slightly stimulating, may be employed. When the pain has not been severe, we have known instances in which the induration was dispelled after strapping the whole organ with plaster, having first covered it with ceratum hydrargyri comp., or strapping with emplastrum belladonnæ alone. All direct local pressure should be carefully removed; and if the breast be pendulous, it should not be allowed to hang loosely without some support.

Effusions of blood caused by contusions.—Injuries of this kind produce swellings of greater or less magnitude in the breast. If the blood be extravasated within the fascia of the gland, the skin does not always show ecchymosis. But the history of the case will generally aid in the correct diagnostication of the disease.

Of course such a swelling may show itself at any age after the development of the organ, and in whatever state it may be; therefore some difficulty may not improbably arise in distinguishing between a tumour formed by extravasated milk and one by blood, but galactocele is not often associated with violence well known to have been inflicted, whereas the blood-swelling always is. The first is painless usually; the last is accompanied with considerable pain. Inflammation and suppuration take place in these blood tumours rarely; they generally diminish slowly, and at last disperse. A slightly stimulating lotion applied to the part hastens absorption of the blood.

Ecchymoses occasionally appear in the integuments over the breast in association with amenorrhœa; and discharges from the nipple of a blood colour escape, under similar circumstances, which must be carefully kept distinct from those which occasionally accompany carcinoma of the gland.

Hyperæsthesia.—Under the term more commonly in use, 'irritable mamma,' is understood an exalted state of sensation in the skin covering the breast, as well as of the gland itself.

The suffering which patients undergo is sometimes most intense. The very thought of a person touching the part adds to the torture, and even the gentle contact of the dress can be scarcely tolerated. The affected breast is usually larger than when in a healthy state; it is firm, conical, projecting; the skin is generally red, from its blood-vessels being congested; the nipple is prominent and appears swollen. This state of the breast is very variable from day to day, the pain being sometimes confined to one gland only, at other times occurring in both, and occasionally alternating between one and the other. It will also suddenly cease, and return again as unexpectedly and without any assignable cause. Nor is the pain confined to the breast; it extends to the spine, neck, shoulders, arms, and hips. Young girls are more frequently thus afflicted than females above the age of twenty-five. Generally this affection is associated with an utterly disordered state of every function, a nervous excitable temperament, and especially derangement of the catamenial discharge, dysmenorrhœal, amenorrhœal, or the contrary. This condition is doubtless excited by sympathy with the pelvic generative organs, and may probably be excited by indulgence in depraved habits. Its treatment consists in enforcing strictly hygienic measures—all the excretions must be restored to a normal state, from which they generally widely depart—and the application of some soothing lotion at the moment of the more acute paroxysms of pain.

FUNCTIONAL DISORDERS.

Abnormal secretion of milk.—This anomaly relates to the age of the woman, and to a condition unassociated with pregnancy.

Cases are recorded in which the breasts of old women have secreted milk;* others in which the secretion was formed at a very early age† (eight years); and of some women, reputed virgins, whose breasts secreted a troublesome amount of milk.‡

Agalactia, or want of lactic secretion, depends upon an organic imperfection of the gland, as already stated (p. 218), and occasionally upon constitutional causes. This secretion may be excited by the application of the leaves of the castor-oil plant to the breast,§ as well as by warmth and moisture, and the stimulus of the act of suckling.

Galactorrhœa.—This term expresses an excessive secretion of milk, which is constantly flowing away; as well as the continuance of the secretion after weaning, either at the conclusion of a proper period or as the result of a sudden removal of the suckling.

These conditions usually affect delicate females, and are associated with some derangement of the catamenial function. Measures to improve the general health must be enforced, and such medicines as give tone and power to the system should be administered. An application of the extract of belladonna over the breast, or even strapping it with adhesive plaster, will in some cases be useful. We have seen the preparations of iodine and of iron, given separately or in combination, exert a beneficial effect in these cases. Dr. Laycock recommends hemlock, used as a poultice, and given internally with opium in pills.

Congestion with milk.—The gland sometimes becomes excessively congested with its own secretion. This seems to depend on the more solid constituents of the milk being formed without the serous. For the more fluid portion appears to be an important agent, not only in diluting the nutritious element, but in favouring its ready escape.

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* *Abridgment of Phil. Trans.* vol. iii. p. 80; Diemerbröck, *Anat. corp. Human.*; Riberi, *Raccolta delle Opere Minori*, 2 vols. 8vo, Turin, 1851; Livingstone, *Missionary Travels, &c., in South Africa*, p. 126.

† Baudelocque, *Art d'Accouchement*, tom. i. p. 188.

‡ Riberi, op. cit.; Heister, *Obs.* cclxxiii. p. 325; John Dix, in *Med. Times and Gaz.* p. 89, Jan. 1856; Braithwaite, *Retrospect*, vol. xviii. p. 376; Cases in *London Journal of Medicine*, vol. i. p. 85.

§ The *Lancet*, Sept. 1850; *Edinb. Monthly Journ. of Med. Science*, Oct. 1850; *London Journ. of Med.* vol. ii. p. 951.

It is probable that the sensation experienced soon after the infant is placed to the breast, called 'the draught,' is produced, by more blood being distributed to the gland, and a rapid development of serum taking place. In cases of the kind under consideration the breast assumes enormous proportions. It becomes of stony hardness. The skin is stretched, not much changed in colour at first; the nipple seems to be drawn in, but is rather imbedded in the skin, which is raised up around it, and flattened; the local pain is not severe; and although the mind is much disturbed by apprehensions regarding the nature of the disease and its ultimate results, the constitutional effects are not nearly so severe as, *à priori*, might be expected. The progress of the disease is excessively slow. Generally it terminates in inflammation and abscess. We may here observe that the morbid affection is usually confined to one breast, and that the function of the other one is performed in the most healthy manner. Also, that we have seen cases in which the gland, after regaining a healthy condition, was competent to the performance of its function at a subsequent parturition. The disease for which this one is most likely to be mistaken is carcinoma. But that disease is so excessively rarely developed during suckling, that the bare suspicion of it may be at once banished; especially if undoubted evidence can be obtained that there was no tumour in the breast before the birth of the child. The plain fact that the morbid state of the gland is immediately associated with the activity of the organ is, when accepted as negative evidence, almost pathognomonic of the nature of the diseased action. The treatment consists in strapping the whole breast with adhesive plaster, in the application of an ointment of iodide of potassium, iodide of lead, or the tincture of iodine, and in improving the general health.

SPECIAL DISEASES. DIVISION II.

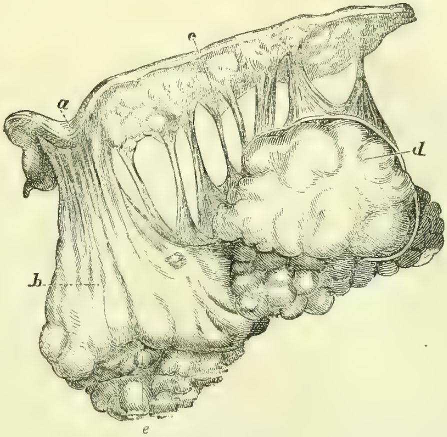
NEW GROWTHS, FORMING TUMOURS, THE ELEMENTS OF WHICH MORE OR LESS RESEMBLE THOSE COMPOSING THE GLAND.

Adenoma.—This term is employed to indicate a kind of new growth, the tissues of which closely resemble those of the breast-gland itself. It is synonymous with the following designations: 'Chronic mammary tumour,' Sir A. Cooper; 'Pancreatic sarcoma,' Abernethy; 'Tumeur adénoïde,' Velpeau; 'Corps fibreux,' Cruveilhier; 'Hypertrophie partielle,' Lebert;

'Mammary glandular tumour,' Paget; 'Hydatid disease of the breast,' Sir A. Cooper; 'Carcinoma hydatides,' Sir C. Bell; 'Sero-cystic sarcoma,' Sir B. Brodie; 'Cysto-sarcoma,' Müller; 'Tuberous cystic tumour,' Cæsar Hawkins; 'Proliferous cysts,' Paget. Such a variety of names is sufficient to indicate the extreme diversity of outward form seen in these growths. Following their structural arrangements, we may make such a natural division of them as to include in three principal groups all the varieties met with in practice.

The accompanying woodcut demonstrates the relation of such growths with the mammary gland.

Fig. 330.



Adenoma of mammary gland; the breast and the new growth dissected to show their relations to one another. Removed from a single woman, æt. 26. Six years' growth. Guy's Hospital Museum, 2292^{5}. *a.* Site of nipple. *b.* Breast gland. *c.* Suspensory bands between skin and growth. *d.* New growth surrounded by its fibrous envelope. *e.* Several small cysts with mucous contents.

In the *first group* the growths are compact, dense, firm, fibrous. lobulated, and invested by their own fibrous capsule. The varieties in this group consist of new growths, in which the observer may detect ducts, sinuses, and even the secretion peculiar to this gland; of others, very succulent, in which ducts are traceable in progress of development; and of those not succulent, very fibrous, crisp, dense, minutely lobulated and possessing the cæcal terminations of the ducts only. The surface of a section of the tumours in this group shows a very variable arrangement of the elementary structures. In some it is quite smooth, divided into larger or smaller lobes, and compactly united together by connective tissue; in others it is broken up by fissures running in all directions and without any definite order; whilst in others, the surface is as irregular as it is possible to conceive, and appears as if the minute lobules would drop off from the general mass.

In the *second group* are cystoid* formations having growths within them which appear to spring from their walls, are floating and pedunculated, or sessile, and have very little connective tissue between them. These intra-capsular growths are often bathed in fluid. Variety appears in this group by the tumours being composed of large lobed, pedunculated masses, not connected together, although each lobe consists of lobules containing acini and the cæcal terminations of the ducts, together with connective tissue. In other specimens the small lobulated masses are attached to membranous septa from which they are pendent; and in others sessile masses are dispersed upon the wall of a large membranous capsule which contains the characteristic serum. This fluid is usually of a pale yellow tint, tenacious, adheres to the fingers, and draws out in threads. Any deviation from this colour is due to the admixture of colouring matter from the blood.

In the *third group* we arrange those cystoid formations referable to the dilatation of the ducts or sinuses, and connected with them, which contain growths apparently springing from their walls and composed of tissues resembling those of the gland. Sir B. Brodie first described them, and they are very rare (*Lectures on Pathology and Surgery*, Lect. vii.). A drawing of a very remarkable specimen of this disease is published by Dr. H. Meckel in the *Illustrirte Med. Zeitung*, 1852, b. i. It is the finest one delineated.

Adenoceles usually commence as a hard nodule upon the cutaneous surface of the breast, in its substance, at its border, or behind it. In some instances their mobility and isolation from the organ are aids towards diagnostication; but when they are imbedded in the gland, or developed behind it, these features are not recognisable. When the new growth has reached a considerable size, the true breast is frequently atrophied. Rarely both the right and left breast have tumours developed in them, and it is uncommon to meet with two or more in the same organ. We have been unable to prove that one breast is more liable to this affection than the other. A patient was, however, under my observation, in whose breasts numerous tumours were developed, varying in size from half an inch in diameter to two or three inches. The rapidity of their growth varies greatly in different patients. Those possessing a cystoid character increase more rapidly, as a rule, than the dense, compact, fibrous structures. In several museums enormous masses of all kinds are preserved, which weigh many pounds. The integuments usually accommodate themselves to the stretching

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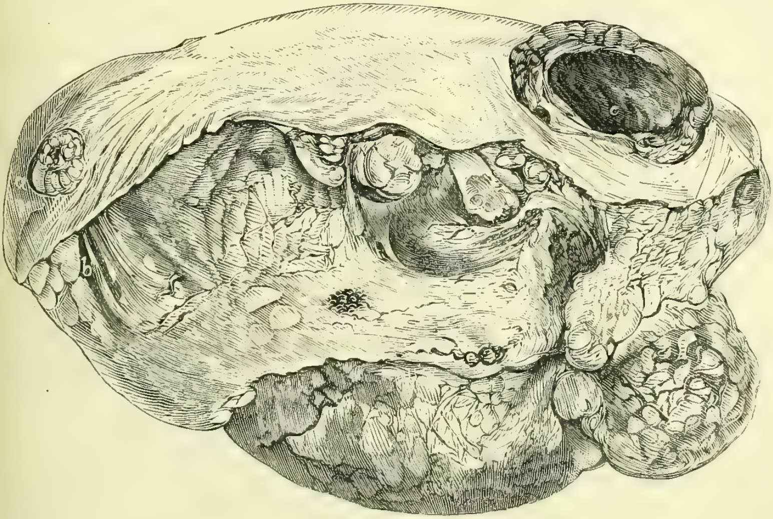
* These so-called cysts resemble much rather the arrangement of the capsular ligaments of joints attached around the articular ends of the long bones than genuine cysts. It would be much more easy to comprehend the nature of both true cysts and of these envelopes of the new growths, if the word 'cyst' was exclusively restricted to a circumscribed cell or cavity bounded on all sides by a continuous membrane. In these adenoid growths, for the most part, it is the envelope or capsule of the new growth detached from its surface by the accumulation of fluid simply, which constitutes the so-called cyst. As this fluid is either absorbed or not secreted, the growth seems to encroach upon, or fill up and obliterate the cyst; but without the growth increasing, if the fluid disappears, the capsule becomes compressed upon the surface of the new growth, and is more or less adherent to it.

Fig. 331.



The woodcut represents a fine example of the combination of the solid and cystiform growths developed in the breast of a middle-aged woman. The whole tumour was very large, and was removed by the late Mr. Aston Key. The wasted mammary gland overlies the growth on its left, and the nipple and ducts are indicated by the letters *a*, *b*. At the right of the tumour the integuments had ulcerated, and the letter *c* points to the growth projecting slightly through the hole in them. The drawing and preparation are in the museum at Guy's Hospital—No. 402^{75}; 2294.

to which they are subjected without ulceration taking place, although in some few instances we have seen them become gradually thinner and thinner over a single cyst, and ulcerate. This allows the escape of the serum, after which a hole continues in the skin, the features of which are distinctive of the disease beneath. The edges of the ulcer are thin and lie flat upon the intra-capsular growths, neither inverted nor everted; they are not even adherent to it, but can be raised from it with facility. In one instance, and where the tumour was not large, the integuments sloughed, after which the whole mass projected through the opening in the skin and formed a red fungating growth, which assumed the aspect of cancer. As a rule, the more dense and fibrous kinds grow slowly. I lately removed one of twenty-five years' growth which was only about four inches in diameter. When in the gland of a young girl, their rate of progress seems commonly to be from about half an inch to one inch in twelve months. Such, at least, is the nearest estimation I can form, after watching them in patients who would not submit to their removal. Having attained a moderate size, their growth sometimes ceases. Those tumours associated with cysts always grow the fastest. One notable exception to this we have observed. It occurred in a maiden of twenty-three years old, from whom Mr. Nathaniel Ward removed a tumour of two pounds weight, which had grown in about eight weeks, according to the statement of the patient. It was chiefly composed of succulent fibre-tissue and the epithelium of the mammary gland-ducts and cæci.

Sudden and rapid increase in size occasionally happens in these cases, accompanied with more or less redness and vascular congestion of the cutaneous covering. This change is due to two causes operating upon the tissues of the new growth. One is inflammation, passing on to destruction or necrosis of its central portions; the other depends upon intra-capsular hæmorrhage. A case of this kind is reported by Mr. Bryant.* In another case,† under the care of Mr. Kellock and the writer, a sudden enlargement of the tumour was observed a few days before parturition. The growth was of several years' development; and when removed a large cyst was found in it containing a mixture of milk and serum.

Growths of the firm, fibrous kind are frequently developed behind the true gland, which is atrophied. The accompanying woodcut displays the arrangement of the tumour thus disposed. It was formed behind the wasted breast of a single woman, forty-three years old, and had been observed about three months. The removal of this tumour was effected fifteen years since, and the patient is at this time quite well.

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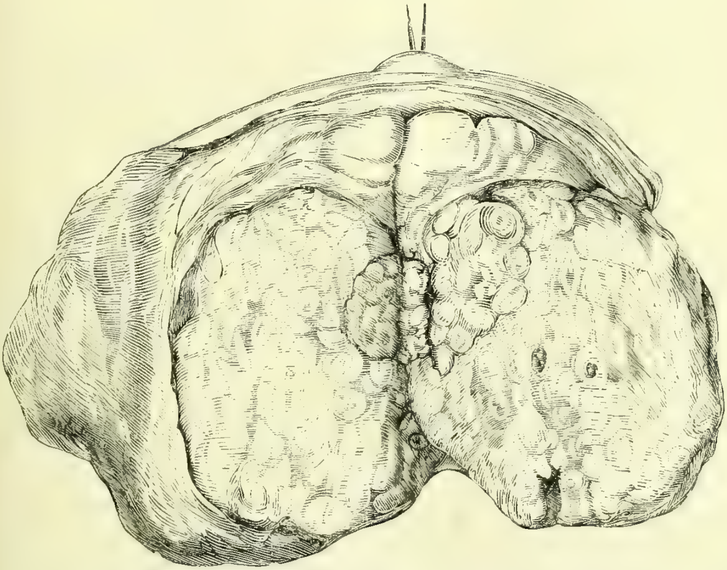
* *Trans. Path. Soc.* vol. xii. p. 222. † Ibid. vol. ix. p. 386.

These tumours are developed at any age, about puberty or subsequently. Sometimes they form simultaneously with the development of the gland, rarely with the changes taking place during pregnancy, but most frequently at the stage of passive maturity of the breast. Thus, of any large number of cases, the third decade of life, which includes the ages between twenty and thirty years, offers the majority of examples. But care must be taken to note the age of each individual at which the tumour was first observed, and not that at the moment of examination. The writer found the proportions to be as follows, in 125 cases, from birth to fifty years old. During the first ten years there was not a case; from ten years to thirty, 90 cases; from thirty to fifty, 35. In a very large majority of the cases, the women were single when the tumour was first noticed; and when married women were the sufferers, the majority had been prolific. The patients

Fig. 332.



A section of the tumour is represented, enclosed in a well-marked envelope. Overlying it, and also on its left side, is the atrophied breast, and at the top the nipple is seen, with two bristles projecting from the mouths of the ducts. A coloured drawing and the preparation are now in the museum at Guy's Hospital. Drawing 404⁵; preparation 2299⁵⁰.

were generally remarkably healthy. Very little inconvenience is caused by the growth in its early stage ; indeed, very often the patient is only made aware of its existence by accidentally touching it. In a very few cases the discovery of the 'lump' was preceded by a contusion. Just before the catamenial period a little pain may be felt ; but that, perhaps, does not exceed the usual irritability of the organ prior to its recurrence. Even when of great magnitude and their bulk intolerable, the freedom from pain is remarkable. It is right, however, to state that in a few cases we have known the patient to complain of severe pain ; and that, in one instance, with this accompaniment, a filament of a nerve was traced into the new growth. The general health of the sufferer is unaffected in the first instance ; but at last the bulk of the growth, and the mental anguish induced by anticipation of its results or necessity for an operation, prey upon the constitutional vigour of the patient, and it becomes impaired, whilst, at the same time, the facial aspect is indicative of depression and anxiety.

Of recurrence and alternation of these growths after removal.— The growths classed together in the first group very rarely re-appear after excision. We have never seen a recurrence in a patient in whom the tumour was developed before thirty years of age. But in older women, and especially when the tumour resembles those constituting the second group, recurrence is not infrequent, particularly if the entire mammary gland has not been carefully removed with the tumour. The truth is, that the more closely the tissues of these growths resemble the elements of the fibro-plastic formations, the greater will be the probability of their re-appearance locally, and, we may also add, in one or other of the internal organs. An interesting feature of those cases in which the mammary growth has been repeated, consists in the varieties of the first and second groups alternating with each other. For example, the first growth may be solid, firm, fibrous, and its section resembling the cut surface of the mammary gland ; but the second tumour shall have the cystoid formation ; whilst a third may assume all the characteristics of the first. And often, in different portions of the same tumour, these growths are found associated together, invested by a common envelope. Do we not in these loosely constructed growths recognise the propriety of applying the term 'capsule' to the fibrous membrane surrounding the adenoid growth, rather than adhering to the word 'cyst,' which carries one away from the relations really subsisting between the capsule and the new growth within it? *

Diagnosis.—The age of the patient and her healthy aspect; the shape of the breast, the locality of the growth, in many instances, its firmness, mobility, and freedom from pain, except perhaps after pressure,—are the chief points from which aid is derived in correctly diagnosticating the fibrous compact varieties of adenocele, developed in the breast of maidens *before* thirty years of age. After this period, the cystoid varieties most commonly prevail. These tumours are characterised by their nodulated and lobulated surface, in which irregularity of course the integuments participate, so that the uniform roundness of the surface of the breast is marred. The elevations and depressions correspond with the collections of fluid and masses of solid new growth. Often when the finger is pressed over the most prominent, the fluid can be displaced, and the indented surface of the intra-capsular growth detected by sight as well as by touch. A combination of these capsules with their solid contents, in larger or smaller masses, together with perfectly solid growths, can be diagnosticated by manipulation. In some cases the bold relief of the tumour upon the thorax, and its striking projection against the integuments, as if it were ready to burst through them, is highly characteristic, especially in marking the important distinction between an independent new growth developed in the organ and those new formations which, infiltrating the tissues of the gland, do not essentially interfere with its normal outline.

The *prognosis* of this tumour is for the most part favourable. When the growth belongs to the first group, it is always so. But when the fibro-plastic elementary tissues appear, the surgeon must bear in mind the statements before made, and pronounce with caution.

The *treatment* consists in removing the tumour by excision. We have never seen the slightest advantage gained by local applications, nor are we disposed to admit that a genuine new growth of the nature before described is ever absorbed. Isolated and circumscribed lobules of the true gland, which from their hardness and mobility closely resemble these new growths, certainly disappear when the healthy condition of the gland is restored; but is a genuine new growth ever absorbed? We believe not.

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* Brevity being compulsory, the reader is referred to a paper on adenocele in *Guy's Hospital Reports*, 1855, in which a large number of cases is reported by the writer.

On small tumours the operation is very simple. The integuments should be stretched over the growth tightly, and the point of the scalpel inserted sufficiently deep to penetrate its anterior surface to the depth of about a quarter of an inch. The capsule is thus cut by drawing the edge of the scalpel through it. Its handle is next made use of to detach the connections between the capsule and the growth, and where the fibrous tissue enters between its component lobes the blade is used. After this manner it is easily enucleated, without cutting the breast-gland itself. When the adenocele is covered anteriorly by the gland-tissue, the operator must make an incision through that structure, and open the capsule as before described. The edges of the wound are to be kept in close apposition with plaster. This proceeding should be adopted in the majority of patients under thirty years of age. As a rule, however large the growth, the gland should be sought out and preserved, if practicable, in young child-bearing women.* After thirty-five, unless in exceptional cases, we deem it preferable to remove the entire breast with the growth.

Duct-cysts.—Perfectly closed cysts, and others so called, but having an opening communicating with a duct, which in some instances is so large that the swelling assumes rather the character of a dilatation or bulging of the walls of the tube, are frequently met with in the breast. Their contents more or less closely resemble the mucoid secretion found in dilated ducts. Hence their assumed origin and the term by which they are designated, duct-cysts, retention-cysts; or, from the nature of their contents, mucous cysts.

The wall of the cyst is usually thin, firmly united to the surrounding parts, and consists of fibre-tissue. Its interior is smooth, and covered with squamous epithelium. The contents are either a thick tenacious mucus of a dull green, yellowish, or brownish tint, and slimy, greasy consistence, which renders water turbid, but does not readily mix with it; or, if the cyst be large, the fluid is more serous, with an admixture of blood, causing its colour to assume a dark red, brown, or blackish hue. Laminæ of chloresterine often float in the fluid. Sometimes only a single cyst forms in one breast; in other cases cysts abound in one or both. Indeed, one rarely fails to find some of them of minute size, if the gland of a woman of middle age and who has suckled several children be examined after death. Of course, examples of this kind give no trouble; but when the tumour reaches one or two inches in diameter, and produces a hard, fluctuating swelling in the breast and a blood-coloured fluid oozes from the nipple, considerable alarm becomes excited. Such swellings are developed in any part of the breast. Most commonly, however, when large they are placed superficially, near the areola, and in the neighbourhood of the larger ducts. When numerous and minute, the posterior and peripheral regions of the gland seem to be the parts usually selected for their development.

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* The reader is referred to Mr. Stanley's case, preparation No. 208, in the Pathological Museum at the Royal College of Surgeons; the report of the case in *Guy's Hospital Reports*, 1841, p. 203; and its subsequent history in the volume for 1855, p. 144, case v. Also another case, with a milk cyst, p. 139, case i., in the same book. This last-mentioned patient is now well.

This disease is always met with in the passive state of the gland, and in adults who have reached or passed the middle period of life. It occasionally occurs in single women, but most commonly in those who have been mothers and suckled children; although married but sterile women are not exempted. In different cases and at various stages of the growth, the accompanying pain differs much. In some, this morbid condition is painless. When the cyst is very large—a condition which however, rarely happens—the fluctuation of its fluid contents is very distinct; and when small and numerous, the same may be detected in the separate cysts, although they often feel so very hard as to deceive the careless observer. By gentle compression of the cyst the fluid sometimes escapes from the nipple, which occurrence may almost be accepted as pathognomonic of this disease, and especially, too, if the cyst can be thus entirely emptied. But should a solid substance be felt after the escape of the fluid, the probability is that some other disease exists, associated with the cyst. As the cyst enlarges, the integuments covering it become thinner and thinner, until the coloured fluid it contains produces discoloration of the skin. Such altered colour of the tegumentary texture, from that circumstance alone, is a notable fact, and one which must not be confused with the colour depending upon congestion of its blood-vessels, or infiltration by inflammatory or other products. The tint of the overlying skin is either pink, red, purple, or brown. At length ulceration of the skin takes place, if the disease be allowed to take its course, and the fluid contents of the cyst escape. In some cases the opening heals; but, as the wall of the cyst remains, it soon becomes again distended with an accumulation of fluid. We have known this operation to be repeated over and over again, occupying a period of several years, and merely giving rise to trouble and annoyance.

This disease being of purely local origin and usually occurring at a period of life when the organ is no longer required, two methods of treatment are offered for selection. The palliative treatment consists either in emptying the cyst by compression, when its contents flow freely from the nipple, or by making use of a trocar and canula for the same purpose. When several cysts exist, a radical cure can only be effected by the removal of the entire breast. If only one cyst, incision and exciting inflammation of its walls will cure it. All external local applications are unavailing for the cure of the disease; but if a single closed cyst exist, it may be emptied, and a drachm or less of the tincture of iodine injected and allowed to remain there. Obliteration of the cavity sometimes follows this treatment. When the disease originates as above described, to the exclusion of every other, the prognosis is favourable; but it cannot be denied that a great tendency to the development of these cysts exists in association with carcinoma. In certain cases, therefore, a guarded prognosis is desirable. Preparations illustrating this disease are to be seen in the College Museum, Nos. 2742, 2744; and in Guy's Museum, Nos. 2290^{55}, 2290^{63}, and 2290^{70}.

Galactocele—a milky tumour, or a swelling caused by rupture of the milk-tubes and escape of their contents into the surrounding connective tissue, or dilatation of a lacteal duct or its sinus from obstruction—is rather a rare disease, and always developed during the active state of the organ. If it occur at an early period of lactation, and in consequence of rupture of a large duct or one of the sinuses, fluctuation is perceptible in the tumour, which forms quickly and increases rapidly and distinctly during every time the infant sucks. On the other hand, should the extravasation proceed slowly, but little observation is taken of it; and having attained variable dimensions, the tumour sometimes remains without alteration for some time.

These cases being rare, the following instance is here introduced. A very healthy-looking married woman was twenty-two years old when her first child was born. Soon afterwards a tumour formed in the left breast, which after five months' duration was punctured, and serum escaped. She did not suckle with that breast. She gave birth to six more children, and at each parturition the tumour increased in size, but diminished as soon as lactation ceased. She came to me with a tumour of thirteen years' duration. It was soft, globular, and somewhat nodulated. An incision was made into it, when ten ounces of thick cream flowed away. The wound quickly closed by granulation.

The serous portions of the milk being absorbed slowly, the more solid, fatty constituents remain, causing the swelling to decrease and to become firmer. It may at last feel quite hard, the cyst-wall becoming rigid and crisp, which depends upon the deposition of earthy salts. In this stage a difficulty may arise in distinguishing the precise nature of the tumour. The swelling, during its formation and subsequent progress, is unattended with pain; the colour of the overlying integuments is unchanged, and the general health is not affected.

The diagnostication of the swelling is made, when first formed, by calling to mind the condition of the organ at the moment of its development; its sudden formation during suckling, and the changes produced in it concurrently with that act; the fluctuation; the unaltered colour of the integuments; and the freedom from constitutional disturbance. At a later period, the surgeon must be guided by the history of the case, its negative indications, his experience of other tumours in the breast, and by manipulation.

The treatment consists in incising the integuments and the cyst, allowing the free escape of its contents, and exciting the wound to heal by granulation.

A preparation showing the lactiferous tubes dilated and filled with milk is preserved in the College Museum, No. 2741; and others, showing a cyst which contained milk, in Guy's Museum, No. 2290^{80}, one a mass of casein, 2299^{40}, and 2290^{50}.

Sero-cysts are characterised by the nature of their contents, the globular outline of their form, the simplicity of their structure, and their harmless influence. The cysts so commonly found associated with the new growths termed adenocele are designedly excluded from this category, as their contents are peculiar and characteristic.

The fluid of the true sero-cyst is limpid, and nearly colourless, or very pale yellow, or light brown, and sometimes just tinted with the colouring matter of the blood. It is clear, occasionally very slightly turbid, and never tenacious. It shows an alkaline reaction. Neither the application of heat, unless the fluid be very alkaline, nor the admixture of nitric acid, cause any coagulation, although a very slight flocculent precipitate may subside as the liquor cools. The cyst-wall is very thin, composed of fibre tissue, firmly attached to the surrounding parts and lined with squamous epithelium. It is always perfectly closed, and never communicates with a duct. Usually a single cyst only is found. Its existence is discovered by the patient, whose attention is drawn to a painful spot, perhaps, where the finger detects a small hard 'lump.' This discovery may have been made some time after the receipt of a contusion in the region, which merely produced temporary pain, and was subsequently forgotten. Other cases have occurred, for which the patient was totally unable to assign any local cause. As the fluid slowly accumulates the tumour progressively enlarges, and if seated superficially, elevates the skin, producing, therefore, unusual fulness of the affected organ. If it be near the nipple, that organ is sometimes pushed aside; and if the maiden state of it exists, it may be flattened out and lost to touch, although traceable by sight. It is never really retracted. The skin at last becomes much stretched over the tumour, without showing any other marked structural change, and by a careful adjustment of a strong light, the surface of the swelling appears translucent. Fluctuation is now distinct, together with the characteristic vibration of a circumscribed collection of fluid when gently and suddenly tapped with the finger. By degrees, the pressure of the fluid acting upon the skin, its vessels become congested, and sometimes its capillaries dilated; but there is little really inflammatory action until the last moment. Then ulceration takes place at a very small spot, the fluid flows out, the cyst collapses, and a serous scarcely-coloured discharge continues to escape. That aperture sometimes closes, and never re-opens; in other cases, the processes above described are all repeated. These cysts are developed at a somewhat earlier age than those termed 'duct-cysts'—between forty and fifty. They are generally painless; but in nervous irritable women they are sometimes described as being painful. The general health is undisturbed, and the catamenial function normal.

The treatment consists in emptying the cyst with a trocar and canula, after which an embrocation may be applied over the part, consisting of hydrochlorate of ammonia, spirits of wine, and camphor mixture. Sir B. Brodie states [*] that he has cured cases, probably of this kind, by the mere application of a lotion composed as follows: ℞ Sp. camph. sp. tenuior., ana. fl. oz. iijss.; liq. plumb. diacet. fl. oz. j. This must be applied on a piece of flannel, once folded, over the site of the tumour, renewing it six or eight times in the day and night, until the skin becomes inflamed; then desisting for two or three days, and again using it. He adds that 'three or four weeks,' and in some cases 'some months,' elapse before this treatment is successful in effecting a cure. In eighteen cases which I have myself treated, a single puncture, as above described, was sufficient to produce a cure.

Lipoma and excess of fat.—Masses of adipose tissue are occasionally developed on the breast, within it, and sometimes behind it. As age advances, fat is frequently generated in the place of the gland-tissue, so that what appears to be a largely developed organ, really consists of fat-tissue only, through which a few ducts radiate from the nipple.

But in early life, tumours composed of fat (true lipoma) have been removed from the breast.[†]

Mr. Roper, of Croydon, sent to the Museum at Guy's Hospital several pounds of fat (preparation 2300^{50}) which had been growing in the site of the mammary gland for fifty-eight years. A tumour was first noticed by the woman in her thirtieth year. She died at the age of eighty-seven years, having been merely troubled with the bulk of this pendulous tumour, which measured twenty-three inches around its largest circumference. In its centre there was an irregularly-shaped piece of bone. The same collection contains a portrait of the patient and tumour taken during life.

At an early age, and in persons disposed to obesity, these organs become enormously loaded with fat.

Vascular growths, very rarely met with pure, are generally associated with carcinoma. That is to say, the new growth contains a large number of vessels, and bleeds freely when wounded. The case published in the *Medico-Chirurgical Trans-*

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[*] *Lectures illustrative of various subjects in Pathology and Surgery*, 8vo. 1846, Lect. vii. p. 156.

[†] Remarkable cases of lipoma are recorded, as follows: Sir A. Cooper removed more than fourteen pounds of fat, *Illustrations of the Diseases of the Breast*, p. 67; and another case, p. 68. Sir B. Brodie relates a case in *Lectures on Pathology and Surgery*, p. 271. Warren excised eight pounds of fat, *On Tumours*, p. 228.

actions (vol. xxx.), which is reported by Mr. Image, may be referred to. There is also a case related in the *American Journal of Medical Science*, No. xxxv.

Neuromata are developed on the cutaneous nerve-filaments, as well as probably on those within the breast. Their presence is recognised by the usual indications, which require no special mention here.

Enchondroma and osteoid growths.—New growths of tissues resembling those constituting special systems of the body are very rarely found in the breast. Thus it is extremely uncommon to meet with tumours composed of either cartilage or bone.

Sir Astley Cooper relates the case of a woman, thirty-two years old, who had observed a tumour in her breast for fourteen years. When removed, the growth consisted of two portions: 'the larger portion of it had the appearance of that cartilage which supplies the place of bone in the young subject; the remaining part was ossified.' Also Prof. J. Müller writes,* in reference to four cases of enchondroma: 'In all of these four cases the parts affected were glandular structures, namely, in one instance the parotid gland, in another the *mammary gland*, and in the remaining two the testicle' (Dr. West's trans. p. 102).

In old books we find reports of cases in which bony masses or concretions have been found. In old women, and in cases of extreme atrophy of the breast, the arteries are not uncommonly converted into bony tubes: see preparations in the Museum of the Royal College of Surgeons, 2811, 2812, and one in Guy's Hospital Museum. Of earthy concretions there are several preparations in the Museum of the College (*Path. Cat.* vol. iv. p. 342.)

SPECIAL DISEASES. DIVISION III.

NEW GROWTHS COMPOSED OF ELEMENTS FOREIGN TO THE NORMAL TISSUES OF THE BODY.

Hydatid cysts.—Cysts containing entozoa are occasionally met with in the breast.

Two cases have been seen by the writer. One of them occurred in a woman fifty-one years old; the other was twenty-nine at the time of the operation for the removal of the disease. Both were patients in the hospital. In the elder of the two the swelling in the breast had existed eleven years; in the other one six years. They both enjoyed very good health. The tumours measured about three inches in diameter; they were distinctly circumscribed, firm, painful when pressed, and fluctuation was very distinct. In one case Mr. B. Cooper removed the whole breast, together with the tumour; in the other, Mr. Cooper Forster removed the cyst and its contents only. The large sac containing numerous globular hydatids was very characteristic, and with the aid of the microscope the tentacles of echinococcus hominis were apparent in both instances. We are unable to distinguish between these cysts containing entozoa and others filled with serum or even pus; but the length of time which the tumours have existed, their slow increase, and painless nature, together with the negative evidence to be acquired by sight, touch, and the history of the case, should dispose the surgeon to open the cyst freely before cutting off the whole breast.

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* *Ueber d. feinern Bau u. d. Formen d. krankhaften Geschwülste*; fol. Berlin, 1838.

Fibro-plastic growths.—Under this term we include a class of new formations, the elements of which are nucleated cells of a fusiform or oval shape. The tumour increases rapidly, and becomes much identified with the breast, although the gland-tissue is not infiltrated with the new elementary structures; the integuments ulcerate, and allow a fungating, sprouting growth to burst through the opening. This disease is not very commonly developed in the breast. Sometimes it is associated with adenoid growths, and springs up in the gland of rather youthful women, who seem to be in the enjoyment of remarkably good health. Judging from the cases which have fallen under the observation of the writer, the recurrence of the growth is almost certain to ensue after removal, and the probability of the viscera of either the thorax or abdomen containing identical growths is almost equally great. It chiefly differs from the adenoid tissues in being developed at a rather later period of life, in the rapidity of its development, and by assuming externally some of the appearances of carcinoma. In truth it has not perhaps sufficiently characteristic external indications to enable a surgeon to distinguish between it and carcinoma during its growth, but its elementary constituents differ widely from those of carcinoma. When not interfered with, the tumour often attains enormous proportions, and sometimes the centre softens down, or the whole mass sloughs. It is more vascular and succulent than carcinoma, and when ulcerated often bleeds profusely. The glands of the lymphatic system of the breast are not involved in the disease, even at the latest period. In our experience the removal of the growth has only been attended with temporary advantage, yet we do not hesitate to sanction this step, as it is the only one by which the patient has a chance of being saved from acute local suffering and a speedy death.

Colloid growth.—This new formation, termed by Prof. Müller 'collonema' and 'carcinoma alveolare,' is very rarely found in tumours of the mammary gland. In outward appearance, the new growth termed by Virchow 'myxoma' closely resembles this one. Most specimens of the disease have been taken from other parts of the body. We have seen but two examples on living persons, and there was nothing sufficiently characteristic then to lead to its identification. But it is quite the contrary when a section of such a growth is examined. There is not one so marked, so distinct, so easily recognisable. The transparent jelly-like substance is arranged in compartments, the walls of which are formed of a delicate fibre-tissue. In the specimens we have seen the colour has differed, but that has merely been owing to the admixture of the colouring matter of the blood. Very little change takes place in the appearance of the section after immersion in dilute rectified spirits of wine, but the jelly oozes out slightly and projects from the alveoli, forming a delicate flocculent surface. There seems to be a tendency to local recurrence in these growths, and therefore the whole of the affected organ should be removed; especially, too, as preparations show that isolated centres of the growth are disseminated freely around the principal mass.

Carcinoma, a disease generally known by the term 'cancer,' is more commonly developed in the breast than any other growth. It is found under three very distinct forms. First, the infiltrating kind; secondly, the tuberous; thirdly, the cystiform, or associated with a cyst or cysts.

In the first variety, the normal tissues of the breast, whether in a healthy condition of passive maturity or more or less atrophied, appear to be infiltrated with a fluid and nucleated cells. If the diseased organ be examined at this stage, its appearance, to the unassisted eye, differs but slightly from that of a gland affected with chronic induration; that is to say, it is hard, condensed, incompressible, and sometimes rather granular on the surface of the section. When the part is examined by the aid of the microscope, the nucleated cells, identical with those found in tumours generally acknowledged to be cancer, are easily seen in the fluid oozing from the tissues. In thin sections of such a diseased breast, these nucleated cells are found to be arranged in small groups, between the fibres or stroma of the organ. This stage of cancer has often deceived superficial observers; for cases of this kind have been recorded in which, after the removal of a tumour not recognised to be cancer, that disease has subsequently developed and killed the patient. The entire gland, or a single lobe, may be thus infiltrated. After the lapse of time, the diseased tissues lose their identity, and they become harder, compact, and of a uniform grayish tint. They no longer maintain any resemblance to the section of a mammary gland, although, perhaps, a few ducts may be indistinctly traced. The next marked change is that which is chiefly characterised by the contraction of the growth. The tumour is now as hard as a stone. It may be crushed by pressure, scarcely torn. The surrounding textures, not those of the breast only, are drawn towards it, for it seems to have formed a sort of nucleus or centre, dragging all the neighbouring parts together. Upon the cut surface of such a tumour the remains of the ducts are often traceable, forming a finely reticulated figure. This is carcinoma scirrhosum, or the scirrhous cancer, or stone cancer of old writers and the public; carcinoma fibrosum of more recent authors.

The changes before described, which take place in the infiltrating variety of cancer, may often be observed in the different masses of the same gland after its removal. Thus in one part where the tumour has existed the longest time, and over which the integuments are dimpled or puckered, the gland-structure will be found to be entirely destroyed, and just a trace of ducts perceptible. In this part the active growth of the disease would appear to have become arrested, its progress terminated. We often meet with cases in which the entire gland, having been at one time so infiltrated (in which case the disease usually commences in the centre of the organ), subsides into a mere hard nodule, and gives little trouble, if any at all. In another part, the gland-tissue has lost its characteristic features. The ducts are traceable into it, however, and it may still retain an indistinct lobulation. All the interstitial fat has disappeared. The disease has here been growing a comparatively short time, and in sections of such a tumour the elementary structures of carcinoma are well seen. At another part, the section of the gland-tissue appears to be merely indurated, its lobulation is marked, and small lobules of fat are still interspersed. The condition of this portion is the result of quite a recent change. It is due to the earliest stage of infiltration, and the elements of cancer-growths exist there. Thus these three stages of infiltrating carcinoma may be clearly demonstrated in different regions of the same breast, as well as in three separate glands removed from three distinct individuals. We have not space to give here a description of the minute anatomy of these growths at the three stages above described; but it should be stated that their elementary structures, invisible without the aid of a microscope, are quite as characteristic as the appearances to the ordinary vision.

The tuberous variety of carcinoma forms a distinct tuber or circumscribed mass in the breast, quite within its fascial envelope. Its synonyms are numerous. Thus, if soft and brain-like, C. medullare or cerebriform; if firm and solid, solanoid; if jelly-like, gelatiniform; when black, it is called melanic or melanosis. Having ulcerated through the integuments, it is called fungoid; and if profuse hæmorrhage supervene, the term fungus hæmatodes has been employed to mark the fact. But the single feature which most distinctly characterises this form of carcinoma is its isolation from the gland-tissues by means of a more or less well-defined membranous capsule. Thus the tissues of the breast itself are pushed aside by the encroachment of the new growth, and, as they are not at first absorbed, the dimensions of the affected organ, in comparison with the healthy one, accord with the progressively increasing development of new tissue. Contraction, a feature so characteristic of infiltrating cancer, does not occur in this variety. Therefore the progress of tuberous cancer more or less rapidly advances, in the majority of cases, to the formation of a tumour of considerable dimensions. Distinct and separate nuclei of tubers are occasionally developed in different parts of the same breast. By degrees they coalesce, and form one large growth. Again, the tissues of a single tuber will occasionally burst through their envelope, as it were, and form a very large lobulated mass, which separates the breast into several divisions.

The cystiform variety of carcinoma, or a growth of cancer-tissue associated with a collection of fluid circumscribed by a fibrous capsule or cyst, scarcely possesses sufficient individuality to allow of its admission as a distinct *species*, though its *form* is distinct. The solid growth belongs usually to the tuberous form, and the collection of fluid which always bathes a larger or smaller portion of its surface is really but an accidental formation. In morbid structures of this nature, the cyst seems to have attracted the notice of anatomists in a more marked degree than the solid growth. Thus we continually meet with the expression, 'the growth from the cyst-wall,' whereas, when cases of this description are watched during the growth of the disease, the collection of fluid is often progressively formed upon the surface of a solid tumour. In such a case, the cyst which circumscribes the fluid is a secondary formation, and the solid growth was the cause of its development in the following manner. All surgeons must have observed the quantity of serous fluid poured out from tubers of cancer over which the integuments have ulcerated. This serum flows away, in the absence of anything to allow of its accumulation. But let the fluid ooze from a growth of cancer surrounded by a fibrous envelope, and it will collect, when in excess, between the envelope and the growth, and, separating the capsule further and further, a larger and larger cyst will be developed. Now, if such a tumour be removed, and the walls of the cyst cut open opposite to the growth, the membranous structure falls collapsed, and a solid substance seems to bud forth from its tissues. But make such a single section of the tumour as shall divide the capsule and growth into symmetrical halves, then the relations of the solid growth to the envelope of the fluid will be visible. The observer will notice that he has before him the section of a solid growth of cancer, limited by a more or less distinct membrane, and united with the surrounding tissues of the breast. The 'cyst' will now appear in a different relation. It may be traced in continuation with the fibrous envelope of the tumour, which is, however, more delicate than it, but clearly identical. The surface of the growth, bathed by the serum, has not this envelope; for it has been separated from it by the continual oozing which has taken place, at the same time becoming thicker. Thus the only peculiarity possessed by such a growth of cancer is the addition to some part of its surface of an accumulation of serum in a fibrous capsule. The serum is generally deeply tinged of a brown tint. It is often quite clear.

After standing a few hours in a test-tube, blood-discs are precipitated. Heat, or nitric acid, being applied, more or less turbidity or coagulation takes place. After the serum has been removed through a canula, it generally rapidly collects again. This variety of cancer long ago attracted the attention of surgeons, and several writers have alluded to such cases under the title of 'bloody cysts in cancrous breasts.'

Age when carcinoma is most commonly developed.—The fifth decade of life is that in which carcinoma is most frequently developed in the breast; that is, from the 40th to the 50th year. Before 20 years of age the writer has never seen a case.*

The table below shows the proportion of cases at various ages. Most of the cases were under the observation of the writer; they have not been in any way selected by him, and great care was taken to note the age at which the disease was first observed:—

Age from 20 to 30 years	19
„ 30 „ 40 „	100
„ 40 „ 50 „	193
„ 50 „ 60 „	97
„ 60 „ 70 „	34
„ 70 „ 80 „	6
„ 80 „ 90 „	7
„ 90 „ 100 „	2
	458

Even taking into the calculation the disproportion of individuals alive at any definite periods, the numerical proportion here given shows that an excess of cases belongs to the fifth decade; for only 36 less than half the total number appear in those ten years, or rather more than two-fifths against all the cases at other ages.

The constitutional nutrition of persons afflicted with carcinoma varies, at the development of the disease, between the appearances of robust health and general cachexia. In some cases late in its progress, or even in the last stages, its ravages upon the general health are not very apparent. Some writers assert that, if careful inquiries be made, it will be in most cases ascertained that the state of the general health has been below the average healthy standard for some time previous to the discovery of the disease. But, after the most careful researches in reference to this most important point, the writer has been unable to arrive at any definite results. The statement may certainly be made, without fear of contradiction, that all circumstances tending to depress the vital powers are very commonly associated with the development of cancer. Thus severe mental distress, losses of blood, poverty, intemperance, are commonly marked features in the history of the lives of individuals afflicted with this disease. Still, who would be bold enough to assert, after much experience of the vicissitudes of social life, or of the habits of the people, that these are predisposing causes to its development? Surely, if they were, the disease would be even much more common than it is.

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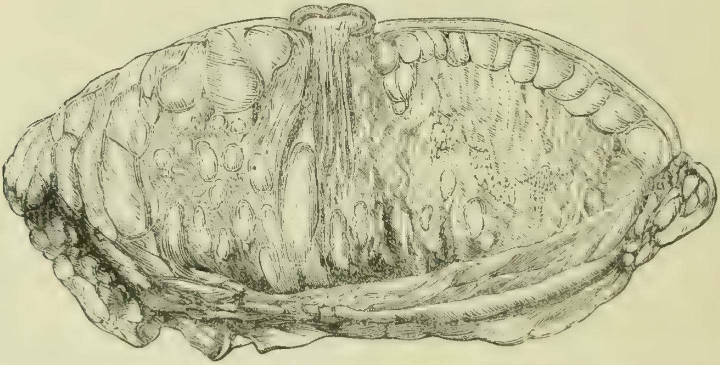
* Mr. Lyford (*Lancet*, vol. xii. p. 332) and Mr. B. B. Cooper (*Lectures on Surgery*, 8vo. 1851) each record a case; the former at eight years of age, the latter at thirteen. In the Museum of St. Bartholomew's Hospital, the preparation ser. xxxiv. 4, was removed from a girl aged sixteen years.

To the cessation of the catamenial function it is usual to refer some baneful influence, and thus to associate cancer with this natural result. But, after careful inquiry, it is found that, of any given number of cases, in a large majority of the women the function is persistent at the moment of the development of the disease. Thus, abstracting this fact from a hundred cases, not selected, but as they chanced to come under observation, we found that the catamenia were persistent in 70, and that the function had ceased in 30 only. Again, the table of various ages (p. 274) shows that the largest number of cases occur between thirty and fifty years, during which period this function is active, admitting its cessation about the forty-fifth year as an average.

Unmarried women are said to be more prone to cancer of the breast than the married, and sterile women rather than prolific. The following facts, derived from an examination of a hundred cases, prove the fallacy of such assertions. Thus, of 100 females suffering with cancer, 86 were married, 14 were single. Of the 86 married women 73 were prolific, 4 had aborted, and 9 were sterile. As regards lactation, the writer has failed in establishing any marked relation between the imperfect performance of this function and the subsequent development of cancer. It is a notable fact, especially in relation to diagnosis, that cancer is very rarely developed during pregnancy or suckling.

The primary development is usually observed in the substance of the breast, upon its surface or at its periphery. The patient very frequently accidentally discovers the hardness first by the touch, neither pain nor uneasiness in the part having been experienced. When the growth is seated at the margins of the gland, or upon its surface, it is frequently very movable, circumscribed, and distinct. If, however, lobular infiltration exists, the tumour seems to form an integral portion of the breast, and its isolation from the surrounding structures is impracticable. Diseased gland-tissue and healthy seem to be inseparably blended together. Often, if the infiltration involves the central portion of the breast, the whole organ feels merely indurated, and is perhaps unaltered in shape. At this early stage there is usually very slight change in form. Unless the patient be very thin, there is no visible sign of the tumour. We assume, at this time, that its dimensions do not exceed two inches in diameter. The progress of the infiltrating variety of the disease may be wholly confined to the breast throughout the remainder of the life of the patient. In such a case the gland-tissue having been destroyed by the new growth, contraction takes place; and the disease, where first observed, subsides into a mere rigid inert mass.

FIG. 333.

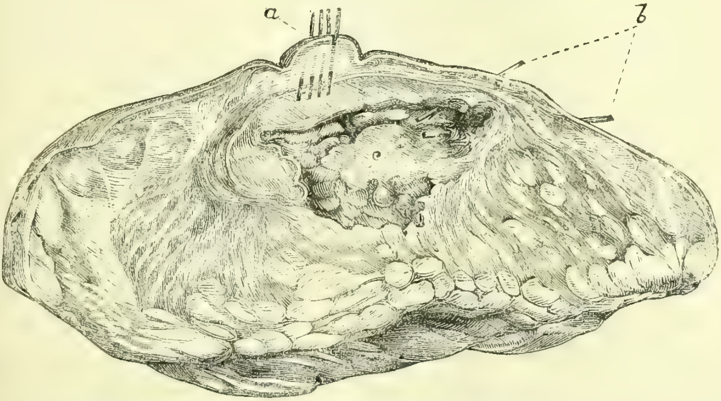


Progressive infiltration of the whole gland is represented in the woodcut, with the infiltration extending between the ducts, and by their side to the integuments. The nipple is not retracted because infiltrated. From a drawing in the museum at Guy's Hospital, No. 413^{38}.

If the growth be of the tuberous variety, a circumscribed swelling is discovered in the breast, which at first increases slowly. But here there is always a visible sign of something new being superadded to the bulk of the gland, so that in proportion to the size of the growth the affected breast is just so much in excess of the dimensions of the sound one. This marked disproportion in the comparative sizes of the two glands, in relation to the quantity of new growth in the one diseased, is much more noticeable in tuberous cancer than in infiltrating. In the early stage, too, the pain in the part is more marked.

Occasionally, at the commencement of the disease, the truly infiltrating form may occur, and during its progress pass into the tuberous. But we do not meet with the opposite condition, at least as regards the gland-tissue. It frequently happens that, during the growth of a tumour or circumscribed mass of cancer, a cyst is formed upon its surface. At least a collection of serous fluid and blood, in relation with the growth, is frequently designated a cyst. In such a case the fluctuation of the fluid is usually distinct. Another change results from the centre of the new growth softening. Whether this process arises from inflammation or the immediate death of the tissues, we cannot here discuss; but the fact is important on account of the alteration it produces in the palpable signs of the tumour. After feeling solid, perhaps rather elastic, fluctuation is detected, and the surgeon hopes the case may prove to be one of chronic abscess. Even the visible signs which subsequently arise may favour the delusion; for the skin, becoming thin and red, *almost* assumes the ordinary appearance of the 'pointing' of pus. The integuments ulcerate slowly. Several openings sometimes form consecutively. But the discharge is never genuine pus. It is curdy or flaky, blood-tinged, it emits a fœtid, perhaps an offensive odour, and a healthy process is not excited. At last,

Fig. 334.



The woodcut shows a section of a growth of this kind, which, softening down in the centre, leaves a hollow. The borders of the growth are seen, and pieces of glass (*b*) passed through the sinuses or fistulæ in the skin communicating with the cavity (*c*). (*a*) Nipple and ducts with bristles introduced. From a drawing in the museum at Guy's Hospital.

the tumour being removed, a section through its centre shows the new growth, with a cavity in its interior; the walls of the hollow being formed of cancer-tissue, usually varying from a quarter of an inch to three-quarters in thickness. The fistulous openings in the skin lead to sinuses communicating with the interior of this growth.

As a rare form of the disease, we must mention that one in which innumerable tubercles are disseminated throughout the substance of the gland; and which, by slowly growing, form larger and larger tubers, until they coalesce into a single mass.

Hitherto we have only described the development of cancer in relation to the breast. But in the progress of the disease all the surrounding structures become involved. Hence there are certain stages of this fearful malady which it is necessary absolutely to describe briefly before alluding to its treatment.

In both kinds of carcinoma, infiltrating and tuberous, the integuments become involved in the disease, but in very different conditions and degrees. In the former, the fat between the gland and the skin becomes absorbed, and the new growth extends along the fibrous septa, infiltrating those structures; and when it has reached the skin, it spreads in that envelope far and wide. The adhesion between the skin and the anterior surface of the breast is very clearly indicated by dimpling or puckering of the integuments over the tumour, and the loss of the natural freedom of movement of the skin upon the gland. Very superficial ulceration next takes place in that part of the skin which has been for some time of a dull red or purplish tint. The ulceration extends deeper and deeper, wider and wider, sometimes leaving a large portion of the breast in a healthy state, whilst it creeps onwards in the surrounding integuments only. Occasionally with merely redness of the skin, sometimes even with scarcely a blush, and in rare cases with an absence of red altogether, the infiltration of the integuments advances, contraction of the infiltrated tissues takes place, and the whole surface of one side of the chest or of both sides is converted into a horny, rigid, unyielding envelope, which entails most acute suffering. Such is the cancer like a cuirass (*en cuirasse*) of the French writers.

In another case, after the skin has become once infiltrated, minute and isolated centres of cancer spring up in the neighbouring integuments, and as they grow, the skin ulcerates, and several detached cutaneous ulcers are developed.

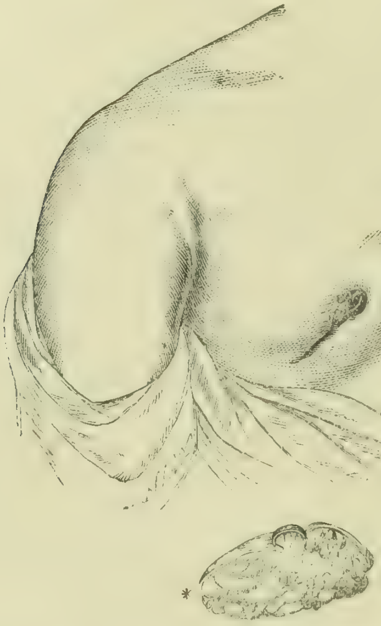
The tuberous variety increases with more or less rapidity, elevating the skin, which becomes thin, its vessels congested, and therefore often of a brilliant hue, shining, and tense. This appearance sometimes closely resembles that of a pointing abscess; but it may be distinguished from it by its slow progress, the little pain accompanying the disease, a more sharply circumscribed redness, and the absence of that gently varying shade of tint from the centre to the periphery of the coloured surface, so characteristic of inflammation. As regards, however, intensity of colour, there is no disease which in this respect at all approaches the brilliant red of some varieties of tubers of carcinoma developed in the skin. The progress of this variety differs remarkably in different cases. The changes which occur are chiefly due either to morbid processes taking place in the new growth, and destroying it, or to the vitality of the growth being maintained when the disease progresses. Thus, two most opposite conditions result. In one, after the integuments have ulcerated, nearly the whole growth sloughs out; in the other, the tumour continues to grow, and a large fungating mass is formed, which reaches prodigious dimensions in some cases. Accompanying this fungous cancer there is generally a profuse serous secretion, sometimes almost clear, but emitting a sickening nauseating odour; at other times a sanious, purulent discharge, mixed with the débris of the growth, the effluvium from which is intolerably offensive. Profuse hæmorrhages commonly take place from such growths, from which circumstance William Hey attempted to establish a special variety of cancer.

The above remarks apply to the most common varieties of cancer affecting the breast. Varieties both in appearance, mode of increase, rapidity and slowness of growth, from infiltration of neighbouring tissues, and from accumulations of serum and blood enclosed in cysts, often occur; into a description of which the limits assigned to this essay do not permit us to enter.

Retraction of the nipple occurs in the infiltrating variety of carcinoma; it does not in the tuberous. It is always most marked when the infiltration is central; and sometimes the nipple may be drawn in and towards the hardness when lobular infiltration only exists. This state of the nipple then is pathognomonic only of the variety of the disease, and of the stage at which it has arrived. It should never be regarded as conclusive evidence of the nature of the disease, but merely as an accidental occurrence.

The nipple sometimes projects considerably after having been deeply retracted. That organ is then infiltrated with carcinoma. When thus diseased, the section, as represented in the woodcut, shows a remarkable prominence of the nipple.

FIG. 335.



Infiltrating carcinoma of the breast and nipple. The uppermost figure shows a projecting nipple though apparently embedded in the adjacent tissues. The section shows a mass of carcinoma surrounded by fat, and the outgrowing nipple also infiltrated. Patient aged forty-five, growth, one year. Drawing in Guy's Hospital Museum, 409^{18}.

The lymphatic glands in the axilla, above the clavicle, and even those at the side of neck, become infiltrated with cancer as the disease advances. Usually, however, the growth in the breast has been observed some months before they are affected, and generally the integuments are more or less implicated before they are deeply involved. Sometimes the disease, first noticed in the breast, seems to remain quiescent, and the axillary growth advances rapidly. As the morbid condition of the axillary glands advances, the upper extremity becomes œdematous, serous effusion into the pleura of the same side takes place, and the sufferer dies without the primary local disease causing much trouble.

The causes of cancer, and hereditary influence, if there be any, relating to its generation, are points belonging to the natural history of the disease, which have been already described in the essay on Cancer.

The treatment of cancer of the breast may be carried out upon two principles. The surgeon has therefore to decide whether the growth shall be allowed to pursue its course under a palliative plan of treatment, or whether the tumour and diseased organ shall be taken off from the body by a cutting operation, or some other method.

There are those who refuse to admit the efficacy of removing a growth of cancer under any circumstances, and there are others who would take it away in every case. A surgeon who would adopt either the one proceeding or the other exclusively must, we think, err in the treatment of this class of cases. The fact is, we believe, that, in a great number of persons, life may be prolonged, local suffering may be prevented, and much mental anxiety is sure to be avoided, by a careful and judicious selection of those cases in which the removal of the primary growth can be easily effected, and in which the constitutional powers of the patient render a surgical operation admissible.

We may here add, in a very few words, that in every case of the kind the state of the patient's general health is of primary importance. If that be impaired, the doubtful issue of an operation would deter most surgeons from recommending a proceeding under the influence of which the sufferer might sink; but when, as often happens, the constitution seems to be unaffected, surely that which the surgeon knows to be a sign, a source, an origin of impending misery, may be taken away with a fair hope of advantage. In order to point out the cases in which the removal of the cancer is neither desirable nor admissible, we may refer the reader to the lecture of Sir Benjamin Brodie,* and to the essay on Cancer.

We consider the operation of removing the tumour, together with the breast, always admissible when the health of the patient appears to be favourable to recovery from that operation, when the disease involves the tissues of the breast only, and when the axillary lymphatic glands are not involved.

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* *Lectures on various subjects in Pathology and Surgery.*

We believe it may be undertaken with advantage when the disease has extended to the skin without infiltrating the cutaneous tissue to a wide extent, when ulceration has taken place, and even when the axillary lymphatic glands are distinctly perceptible and somewhat enlarged. As a general rule, it may be stated that the more limited the local disease is at the time of the operation, the better the chance of a satisfactory result as regards the region, and that if the general health of the patient be well attended to, after the wound has healed, some prospect appears of considerably ameliorating the condition of a sufferer affected by this disease.

We cannot here discuss the advantages or disadvantages of a cutting operation, as compared with the removal of the tumour by other methods. Both means have their advocates; both plans may be adopted in special cases. The one is expeditious, attended with little suffering, certain of removing the whole of the diseased organ. The treatment by caustics is tedious, attended generally with excruciating pain, and very uncertain in its operation.

In comparing the results of the two methods upon the constitutional progress or local relapse of the disease, there is not sufficient evidence in favour of one over the other. Both are commonly followed by a development of cancer either in the region first affected and its vicinity, or new centres of growth become established in distant parts.

The treatment of ulcerated cancer consists in following out the principles applicable to all sloughing open surfaces; thus, all those applications which tend to cleanse the surface are especially serviceable. Lotions composed of solutions of the chloride of zinc, permanganate of potash, ter-chloride of carbon, or chloride of potash, are very useful; with which sedatives, as morphia, solutions of opium, or belladonna, may be combined to soothe the pain. Some substances, applied in the form of powder, as equal parts of chloride of zinc and oxide of zinc, or the former mixed with some farinaceous powder or gum, serve very well to induce a more rapid sloughing of the new growth, and a more tolerable state of the ulcerated surface. By persisting in these applications, the wound occasionally even closes, and a tolerably healthy cicatrisation of the normal tissues is the result.

The hæmorrhages attending these ulcerated and sloughing surfaces may be controlled by cold, by the application of astringent powders or lotions, and other common styptics. When practicable, the slough from under which the bleeding usually takes place should be removed, in order that the styptic may reach the open vessel.

The œdematous condition of the tissues of the upper extremity which in some cases ensues upon infiltration of the axillary lymphatic glands, is a source of great suffering, which it is very difficult to ameliorate. Local means generally avail little. The elevation of the arm assists the return of the serum, and subcutaneous punctures are beneficial.

When a second, a third, or even a fourth or more growths appear, their removal is quite justifiable, provided the constitutional powers of the patient be good, and the local disorder threatens to become a source of prolonged misery and suffering.

The mortality depending upon causes referable to the operation of amputation of the breast is extremely small: the proportion in cases treated in Guy's Hospital being about six per cent.; whilst in private practice it has not amounted to anything like that figure.

The limits of this essay preclude even touching upon the many points of great interest in the natural history of cancer; but the reader may supply the deficiency by turning to that on CANCER, in which the whole subject of the disease is fully treated of. But I cannot conclude without urging the expediency of removing the *first* growth of cancer in *select* cases. I do so upon the firm conviction, based upon experience, that by so acting life may be prolonged; a certain amount of immunity from bodily suffering and mental distress may be insured; the chance of freedom from all local suffering is given; and that, when unhappily the recurrence of the disease gives rise to ulceration, the duration of that distressing state is shortened.

SPECIAL DISEASES. DIVISION IV.

DISEASES OF THE NIPPLE AND AREOLA; THE SINUSES; THE SEBACEOUS GLANDS.

Deficiency of the nipple.—This deformity results from an arrest of its development, or is produced by disease. When, however, a breast exists, there is always a trace of a nipple and areola. There may not be the slightest elevation; even a depression may occupy the site of the mammilla; but the milk-tubes terminate between the rugæ on a small spot of skin. The nipple is often destroyed by disease. Thus gangrene occasionally attacks it, and the whole organ falls off. Also, a nipple once well formed may be drawn inwards or retracted, and so deeply that its extremity is entirely lost to view. But in every case in which a surgeon observes this condition, especially if associated with disease, he should be scrupulously careful to ascertain if the deformed organ was ever perfectly developed.

A bifid nipple is sometimes seen; and occasionally it is ill-shaped, being clavate, pendulous, and covered with small tubercles. Hypertrophy of its tissues occurs but rarely. There are cases on record in which several nipples have been developed on one breast (*pleiomastia*).

Inflammation often attacks the nipple. It is especially prone to this condition during the first occasion of suckling, and with some women at the commencement of every lactation. The most frequent result of that morbid condition is the production of superficial ulceration upon its surface. Small ulcers are formed between the rugæ, on its apex and sides, and sometimes they encircle its base, even extending upon the areola. The abraded surfaces are exquisitely painful, and they often bleed freely. Much constitutional disturbance, mental distress, and acute local suffering are excited by these superficial ulcers, which are commonly termed 'cracks,' 'fissures,' or 'chaps.' It is asserted that these ulcers are frequently engendered by the morbid state of the mucous membrane of the infant's mouth. We have not, however, been able to obtain sufficient evidence of the validity of the statement. As regards treatment;—the most essential point towards remedying these troubles consists in frequent ablutions with warm water, in abstaining from the application of irritating lotions and ointments, but, protecting the part with moist cotton-wool and gutta-percha tissue. A difficulty in most cases arises from the necessity of suckling the infant. Various 'shields' are constructed, therefore, to protect the organ from the pressure and dragging caused by the lips and tongue of the infant. The application of soothing substances is preferable to those which produce pain, and therefore a little glycerine, collodion, or almond-oil is beneficial. Astringent, stimulating, and narcotic applications are not always admissible, on account of the suffering they entail upon the mother, and the risk of injuring the infant. Substances in dry impalpable powder are beneficial. Thus, the oxide of zinc, carbonate of magnesia, lycopodium, prepared chalk, may be tied up in very fine muslin, and the nipple dusted with the particles which pass between the threads. Abscesses, sloughing, herpetic or eczematous eruptions affecting the nipple, require no special mode of treatment.

Hyperæsthesia of the nipple.—We have seen a curious condition of the nipple, but only once, to which the term hyperæsthesia seems the most applicable. The organ became, upon exposure, rigid, its follicles very distinct, its base red, and its point bloodless and hence quite white. It was on the person of a middle-aged, married, but sterile woman, who described the pain as most acute.

Inflammation and abscesses, together with various cutaneous eruptions, are developed in the tissues of the areola. Abscess often forms in the portion of the gland immediately beneath it. The point of chief importance to remember, in connection therewith, is that the lacteal sinuses are placed here, and that great care is requisite to avoid cutting them transversely if a bistoury is required to be used. It is always desirable to allow pus to point very prominently when it is formed beneath the areola; and if an incision be made, its direction should always pursue a straight line radiating from the nipple. The effect of departure from these directions may be the division of a duct; the consequence of which will be that, a fistulous opening being established, the milk will flow freely every time the woman suckles, for it rarely heals until after weaning.

Within the area of the nipple and areola new growths are occasionally developed. Pendulous, cutaneous formations; follicular tumours, or cysts, containing sebaceous secretion; vascular growths of true erectile tissue; epithelioma and infiltrating carcinoma, have all been met with in various degrees of frequency: but as they require to be treated upon the same principles as when found in other parts, it would be idle to dwell upon them here.

SPECIAL DISEASES. DIVISION V.

DISEASES OF THE MALE MAMMILLA.

The affections of the male organ relate to its conditions in a perfectly rudimentary state, and when there is a gland developed; for we have seen and dissected as perfect a passive glandular structure taken from a man as was ever formed in a young girl. Soon after birth the organ becomes tumid, and a secretion forms within the ducts. If left to nature, no difficulty arises. Should inflammation happen, which usually arises from the officiousness of nurses, it must be treated as before described.

At puberty the gland usually enlarges, becomes painful for a few days, and then slowly decreases until nothing but the nipple is perceptible. But if the part be irritated, inflammation running on to the formation of abscess will be excited. In rather delicate men the gland is sometimes largely developed,—hypertrophy. This may occur on one side only, or on both sides. The circumstance generally excites annoyance, but no ill result; although the curious may see in pathological museums breasts of this kind which have been removed and labelled 'scirrhus.' When these breasts are painful, the improvement of the general health is indicated, and all local pressure must be avoided.

The male is subject to deformities arising from excess of mammillæ: thus we have seen a man with four nipples. We have met with a man who had one only, on the right side. The defect was associated with absence of the lowermost fibres of the left pectoral muscle.

The diseases of this organ in the male are of the same kind as those in the female, already described. But disease very rarely attacks this part in a man. We have seen a sebaceous cyst developed close to the nipple and elevating it, and so closely resembling the bluish-red tint of a tuber of cancer just about to ulcerate as to excite grave apprehension; but it was excised with the happiest result. Not long since, Mr. Prescott Hewett* removed a cyst and intra-cystic growth from a man's breast.

Carcinoma is the new growth most commonly developed in the male breast. It occurs generally between forty and fifty years of age, either in the infiltrating or tuberous form; generally, however, in the former, extending slowly, and affecting the integuments in its progress. Its treatment is similar to that adopted in the case of a like disease in the female.

JOHN BIRKETT.

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* *Lancet*, vol. i 1864.

DISEASES OF THE THYROID GLAND.

THE thyroid gland, one of the vascular bodies without ducts, consists of two lateral lobes, connected by an isthmus, which crosses in front of the three upper rings of the trachea. Hyrtl affirms that he has met with instances of complete congenital absence of the isthmus; and in aged subjects it is sometimes so far absorbed as to be scarcely distinguishable, the two halves of the gland appearing to be united only by areolar tissue. The proportion of the gland to the entire body diminishes with age. In new-born infants it is 1:300; at the end of the first month it is 1:1200; in adults it falls to 1:1800.* It is supplied by four, and sometimes by five, large arteries, branches of the carotid and subclavian trunks; the fifth artery, when it exists, lying in the mesial line of the trachea. The organ lies, moreover, in close contiguity to the great vessels and nerves of the neck.

Few surgeons believe that the entire thyroid gland has ever been successfully extirpated, although cases are so related by Desault, Roux, Gooch, Vogel, Theden, Hedenus, and others.

Dr. Hedenus speaks of six successful cases of removal. The operation, as recorded by himself, is as follows:—An incision was made from the os hyoides to the top of the sternum, and the skin reflected from each side to the extent of two inches. The sterno-hyoid and thyroid muscles, which were adherent to the tumour, were cut through in consequence of the hæmorrhage following an attempt made to reflect them. He next separated the swelling above and below from the sterno-cleido-mastoid and omohyoid muscles, and also from the jugular vein and carotid artery (to which it was closely adherent), until he freed it as far as the point where the thyroid arteries originate. He then tied the superior and inferior thyroid arteries close to the tumour, and, on account of the free anatomosis, applied to each vessel two ligatures, and divided it in the interspace. The more deeply the dissection now extended, the more hazardous did it appear. Every four or five lines he was obliged to tie two or three arteries; a proceeding which was effected with great difficulty. After most cautiously dissecting to the base of the tumour, which was attached to the thyroid cartilage and the three upper rings of the trachea, he met with so many arteries, for the most part as large as the radial or ulnar, that in order to prevent further loss of blood, he decided to tie the base of the tumour, and to cut away all beyond the ligature. He accordingly first passed a needle, armed with ligatures, through the base of the tumour, and tied the ends; and next passed another ligature round the entire base, and removed as much as he thought proper. Some local applications, of no importance, were applied. During convalescence hæmorrhage occurred, which was arrested by sprinkling the wound with gum-arabic. On the eight day the ligatures came away. The patient ultimately recovered, and left the hospital well!* These proceedings are scarcely considered admissible in modern surgery.

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* Hyrtl, *Topog. Anat.* b. i. p. 357.

The most frequent affection of the thyroid body is chronic enlargement, or hypertrophy, to which the term ‘bronchocele’ is commonly applied. But under this head are included several morbid changes, all allied to one another in being developments of the natural component tissues of the organ.

A simple bronchocele consists in a uniform enlargement of the thyroid body in all its parts. The texture of the gland is healthy, except that it is coarser than that of a thyroid gland of ordinary size. Very frequently numerous cysts of one or two lines in diameter are found filled with a viscid fluid, or some, fewer in number and of larger size, partitioned and filled with a thin watery or bloody fluid, and scattered irregularly through its substance. As the enlargement proceeds, it may surround and compress the trachea and lower part of the larynx. A case is recorded by the late Mr. Howship, in which the jugular vein passed through the substance of the gland, and the patient suffered greatly from congestion of the head. The two lobes are rarely equally increased in size, the right being more commonly the larger: sometimes, it is said, the middle lobe, or pyramid, is principally affected. In this country bronchocele is more common in women than in men. Cases occur in which young girls, from seventeen to twenty-four years of age, are subject to considerable enlargement of the thyroid body at each menstrual period; the swelling subsiding as that function subsides. I had under my care a young lady, in whom this thyroid enlargement became permanent, after the abrupt cessation of menstruation, caused by her being exposed to cold and wet during a stormy passage at sea. Mr. White Cooper has observed that in persons subject to this affection the eyes are often more than usually prominent. When of moderate size, the disease can be easily recognised, both by its position and by its following the movements of the trachea and œsophagus. It rises if the patient be directed to swallow. But when of larger size it may be known as being unlike anything else. It may be raised with every pulsation of the carotid artery, or hang down in front of the chest, so that it cannot be concealed by any sort of clothing.

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* Gräfe's *Journal,* b. ii. p. 237.

In the severer forms bronchocele or goître is endemic. It prevails in Derbyshire, Nottingham, and the chalky parts of England; in the valleys of the Alps, Apennines, and Pyrenees. Postiglione remarks, that in Savoy, Switzerland, the Tyrol, and Carinthia, there are villages in which all the inhabitants, without exception, have these swellings.* The cause commonly assigned, namely the use of melted snow, or of water impregnated with calcareous or earthy particles, is unsatisfactory. Capt. Alexander Gerard, in his account of Korrawur, in the Himalayas, says, 'although the Korrawurrees can get nothing but snow for some months in the year, they are not so subject to goître as the people who live in the damp grounds in the forest at the foot of the hills, where there can never be any snow-water. The water which flows from the hills of lias, forming the Asiatic side of the Dardanelles, is impregnated with lime; but yet during a residence of many months I did not notice the prevalence of goître.' This idea has been successfully refuted by Alibert; and Foderé has explained how the disease cannot be referred to the use of any particular kind of food. Dr. Guggenbühl, the founder of the Cretin Hospital, remarks that both cretinismus and goître, which may exist either conjointly or separately, prevail in deep valleys, where the air stagnates, and the population, scanty in numbers, becomes deteriorated by frequent intermarriage. Cases of goître and idiotcy removed to an elevated position, and properly nurtured, are first made to thrive bodily, and then are susceptible of mental improvement; and he particularly relates the case of a cretin child, who after having passed a life of apparently complete insensibility to external objects, gave suddenly the first indication of aroused consciousness, after proper treatment, by exclaiming, 'Die Sonne!' (the sun), as the light of day fell on the spot where he was seated. Humboldt says that persons afflicted with bronchocele are met with in the lower course of the Magdalena River, from Honda to the conflux of the Cauca, in the upper part of its course, between Neiva and Honda, and on the high country of Bogota, six thousand feet above the bed of the river. The first of these three regions is a thick forest, while the second and third present a soil destitute of vegetation; the first and third are extremely damp, the second is peculiarly dry; in the second and third the winds are impetuous, in the first the air is stagnant. To these striking differences we will add those relative to temperature. In the first and second regions the thermometer keeps up all the year between 71° and 73° F.; in the third it ranges between 37° and 62° F. The waters drunk by the inhabitants of Maraquita, Honda, and Santa Fé de Bogota, where bronchoceles occur, are not those of snow, but issue from rocks of granite, freestone, and lime. The temperature of the waters of Santa Fé and Mompox, drunk by those who have this disease, varies from nine to ten degrees. Bronchoceles are the most hideous at Maraquita, where the springs, which flow over granite, are, according to Humboldt's experiments, chemically more pure than those of Honda or Bogota, and where the climate is much less sultry than upon the banks of the Magdalena River.*

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* *Memoria sulla Natura del Gozzo,* p. 22.

Dr. John Webster has favoured me with some manuscript notes bearing upon this subject. He says that, according to information collected from reliable sources, there are 500,000 goîtreux persons in France. Some localities in that country are very remarkable for the large number so designated. For example, in a town of Lorraine, having recently 736 inhabitants, there were recognised 164 affected with goître, of whom 143 were females. Of the 164 goîtreux, comprising both sexes, 105 lived in houses having a northern exposure, while only 59 inhabited dwellings fronting the south, and thus enjoying more sunshine than the others. At Rosieux, also in Lorraine, it is reported that every indigent female is goîtreuse. In the arrondissement of Schalstadt, situated in the Lower Rhine department, 658 goitreux were lately registered. A still more remarkable instance of the frequency of the disease occurs at St. Aubin, near Elbœuf, on the banks of the Seine, not far from Rouen, where one female in every 16 of the total population has goître more or less developed. Other places in France might be named where the affection is very prevalent.

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* Humboldt, in *Journ. de Physiologie*, par F. Majendie, tom. iv. p. 116.

In Piedmont and Savoy, especially the latter, goître is very rife. By an official report, continues Dr. Webster, published a few years ago, there were 18,462 simple goîtreux, besides 3,909 cretins. Various mountainous districts in Europe are afflicted with this complaint, which, however, always disappears before civilisation. It becomes rare as persons are better clothed and fed, and are not compelled to intermarry. Prior to 1818, goître was very common in the Swiss canton of Valais, and particularly in several secluded valleys near Martigny. In that year, from the bursting of a lake high up in the mountains, a valley not far from that town was completely devastated; houses, trees, cattle, and people being carried away by the flood. However frequent in this part was the prevalence of both goître and cretinism before the event, it was remarked that subsequently it nearly entirely disappeared, and the reasons seemed the following. Before the great inundation, the soil of the valley was always wet, marshy, and unproductive. By the overflowing of the lake a mètre of good vegetable mould was brought down from the higher regions; the natives were obliged to exert themselves in the cultivation, whereby their physical status was much ameliorated, and the supply of food materially augmented.

At Caneles, near the Cordilleras in North Mexico, many of the inhabitants are grievously affected. Authorities state that half of those employed in the mines are goîtreux, though generally only on one side of the neck. It is affirmed that children born of such parents are frequently idiots, or deaf and dumb.

In the treatment of bronchocele we should be particular to put the patient under circumstances favourable to recovery. In females, the menstrual function generally requires regulation; and a low damp situation should, where possible, be changed for a more airy spot. Blisters have been applied, and kept open; frictions have been recommended; the application of emplastrum ammoniaci cum hydrargyro, electricity, &c., but without much effect.

The remedy most relied on at the present day is iodine, which was first given in the form of burnt sponge; and is now employed both internally and locally, in the different forms admitted into the pharmacopœia. The iodide of potassium may be administered in doses of two or five grains, or even more, three times a day. If more than three grains are given at the commencement, the medicine is often removed in its excess by the secretion of the kidneys. In large doses it is apt to excite salivation, and to irritate the stomach. Iodine was discovered in 1813, by Courtois, manufacturer of saltpetre in Paris; but Dr. Coindel was the first to introduce it into medical practice for the cure of bronchocele. Shortly after its efficacy had been established, Dr. Fyfe of Edinburgh discovered the presence of iodine in burnt sponge.

Cases of enlargement of the thyroid body, demanding the application of ligatures to the nutrient arteries, must be considered exceptional, and modern surgery somewhat avoids the operation. In a case recorded by Sir W. Blizard, the patient died from the effects of hospital gangrene;* but a case reported by Walther of Landshut was successful.† The superior thyroid arteries were successfully tied by Mr. Coates of Salisbury.‡ Mr. Skey observes: § 'While on the subject of tying arteries in the region of the neck, I have referred to the operation of tying the superior thyroid artery as performed by Sir W. Blizard, by Mr. Earle, and others. It is an operation the performance of which is perfectly justifiable, and, as I can testify, is attended with marked diminution of the enlarged structure, if this be the object to be attained: but the relations of the inferior thyroid arteries are so much more complicated, and the artery itself lies so deeply imbedded in the structures of the neck, that I conceive its exposure without danger to be almost impossible.' Thus the question stands; the general feeling being by no means favourable towards the operation.

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* Burns, *Surgical Anatomy of the Head and Neck*, p. 202.

† *Neue Heilart des Kropfes*, p. 25; 1817.

‡ *Med. and Chir. Trans.* vol. x. p. 312.

§ *Operative Surgery*, p. 545; see edit. 1858.

Dr. Murnay speaks highly of the treatment of bronchocele by strychnia. The first case in which he used it was that of a lady aged thirty, who had had good health up to four years previously, when the catamenia became irregular and were attended with great pain on each periodic return. She assigned as the cause of the thyroid tumour great distress of mind and disappointment. When Dr. Murnay saw her, the disease was of six months' duration; the right lobe of the thyroid gland was fully as big as a turkey's egg, extending laterally so as to press on the right carotid artery and jugular vein; a strong pulsation was felt in the tumour, and a purring thrill was communicated to the hand. She had no palpitation of the heart; but she complained of headache, and of a buzzing noise in the right ear; she imagined there was a slight enlargement of the right eye, and that she felt a sensation of fulness in it. The tumour at times impeded deglutition, and occasionally her breathing also. After a fair trial of the usual remedies, strychnia was administered in the dose of $\frac{1}{16}$gr. three times a day. At the end of a fortnight there was great improvement, and ultimately the gland regained its normal size. The second case was that of a housemaid, the enlargement having lasted twelve months, and both lobes being involved. There was great palpitation of the heart, pulse 130, eyes prominent, catamenia irregular, tongue large and flabby, and coated with a yellow fur in the centre; bowels constipated, acting only once a week. In this case the medicine was ordered in a fluid form; one grain was dissolved in seven drachms of water and one of dilute sulphuric acid. She was to commence with five minims three times a day, and to increase to twenty. On the tenth day of taking the medicine, a great flow of menstrual discharge came on, lasted a few days, and returned in a week. The treatment was continued, and soon after the gland began to shrink. The third case was that of a young lady aged fifteen, in which at the time of the report the symptoms were progressing favourably.*

Mr. Hey, of York, has treated bronchocele successfully by seton. The patient was a young lady twenty-one years of age, who had suffered from bronchocele from her earliest infancy. Mr. Hey passed a skein of skin through one half of the gland, commencing at the upper part, in the median line, and, taking as nearly as possible a semicircular direction, brought it out at the corresponding point below: thus embracing half the tumour, at a depth of from three-quarters to one inch, so that the seton was fairly established in the substance of the gland. The patient did not seem to suffer pain, and there was no hæmorrhage of consequence. For the first five weeks no material change took place; the discharge was slight, and it was found necessary to use savine ointment. In the course of the sixth week the patient suffered from a feverish attack; on the third or fourth night after the fever, she was seized with a cough of most distressing character; she became delirious, with brown and dry tongue; this condition lasted forty-eight hours. The seton began to discharge a thin, dirty-looking, and most offensive matter, which relieved the irritation about the windpipe, and the delirium subsided. By degrees the discharge became purulent, and ultimately all signs of thyroid enlargement disappeared.† Mr. Hey remarks, that this operation was known a century ago; but Dr. Quadri of Naples revived it, and practised it to a considerable extent about the years 1817–18. Mr. Copland Hutchinson tried it in 1819.* Mr. T. A. Thompson and others have followed, with generally favourable results. Still the nature of the symptoms here recorded point clearly to chances of risk, and a cautious practitioner should well weigh the necessity of operating at all.

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* *Dublin Hosp. Gaz.* June 1, 1860.

† *Provincial Medical and Surgical Journal*, Sept. 10, 1849.

M. E. Collin, médecin-major de 1^{re} classe, records the particulars of a remarkable attack of acute goître in the garrison at Briançon during the year 1860. The 87th regiment of the line arrived at Briançon on October 22, 1859. During 1860 it represented the garrison of the place, comprising an effective force of 1,062 men. During the year the regiment sent to the infirmary 55 cases of goître. Of these 55, there were 53 acute cases contracted at the town. The attack nearly always commenced after six months' residence. The five months most fertile in the generation of goître were from May to September. M. Collin has called attention several times to the rapidity with which this disease may manifest itself. In certain subjects much predisposed, eight days sufficed for its formation.

Of the 53 goîtres, there were 8 median, 2 unilateral, 27 bilateral, and 16 three-lobed. Of the 27 bilateral goîtres, 20 were on the right side; and of the 16 three-lobed, 10 were also on the right. This latter point confirms the opinion of Alibert, and is supported by nearly all the specimens in the Hunterian Museum. No remedies were found of any avail; and M. Collin very properly recommended either a rapid change in the regiment, or an entire change in the locality of the station. He adds that during winter the ground is constantly covered with snow; and that during that season there is no proper place for exercise.†

Instances are upon record in which bronchocele has proved fatal, by compression of the trachea. One of the latest cases is recorded by Dr. Dickinson.‡ The patient was a tailor aged seventeen. For some time he had had palpitation of the heart, and about eighteen months before his death, he noticed a swelling in the position of the isthmus of the thyroid gland. The swelling extended laterally, so as to occupy the sides of the neck, and he then began to have fits of shortness of breath. In the attacks of dyspnœa the air passed with a hissing sound, as if from constriction of the larynx. He was admitted into St. George's Hospital, where he one night died suffocated, before tracheotomy could be performed. Upon examination after death, it was found that the compression of the trachea, which was very great, commenced at about two inches below the vocal cords, and extended downwards for two or three inches. A preparation, exhibiting in a striking manner the enlarged thyroid gland surrounding and compressing the trachea and the lower part of the larynx, is preserved in the Museum of St. Bartholomew's Hospital. Mr. Macwhinnie * relates the case of a patient aged seventeen, attended by Mr. M'Crea of Islington, where death ensued under symptoms similar to those of strangulation.

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* *Med.-Chir. Trans.* vol. xi. p. 235.

† *Recueil des Mémoires de Méd. militaire*, juillet 1861.

‡ *Trans. of Path. Society of London*, vol. xii. p. 229.

The enlargement of the thyroid gland, which has been noticed not uncommonly in pregnancy, and quite independently of the conditions usually considered to be favourable to the production of goître, is not usually dangerous; but M. Guillot notices two cases under his own care, which show that it may prove perilous to life itself.

A lady æt. thirty, in easy circumstances and of excellent health and constitution, found her neck, during a first pregnancy, become the seat of a slowly-increasing enlargement. During a second pregnancy, in 1835, it increased again and became troublesome. In 1858 M. Guillot saw her with M. Trousseau, as the respiration was much impeded. A few days afterwards, the patient being nearly asphyxiated, laryngotomy was performed with immediate relief, but death ensued in two days.

The second case was that of a young woman aged twenty-nine, the mother of two children. Both respiration and voice were embarrassed, and she was liable to suffocative paroxysms. These symptoms had come on gradually from the time of her first pregnancy. She was admitted into the Necker Hospital, where one of the paroxysms of dyspnœa terminated fatally. The thyroid gland had nearly acquired the size of a human brain; the tissue was healthy in appearance, and there were numerous small cysts scattered throughout its substance.† The author regards the disease as one of the manifestations of the excessive production of fibrine during pregnancy.

Dr. Herbert Davies exhibited at the Pathological Society of London, May 21, 1849, both the thyroid and the thymus glands much hypertrophied, taken from a boy aged sixteen, who died suddenly from a spasmodic affection of the larynx. He had noticed the swelling of the neck about the age of fifteen; the enlargement increased rapidly about four months previous to his death, and it produced a sensation as if he were 'breathing through a sponge.' On examination, the thyroid, thymus, and bronchial glands were found much enlarged; in the last there was a deposit of tubercle. On microscopic examination of the thyroid gland, it was found to consist of the usual vesicles, containing a fluid in which were a large number of corpuscles, the majority of which were smaller than the blood-discs.

Pulsating or exophthalmic bronchocele.—A peculiar variety of bronchocele, distinct from the ordinary goître, and to which various names have been applied, may be here noticed; though, as it forms but one link in a long chain of morbid symptoms, it would be out of place to describe fully the disease, of which it forms but a part, among the affections of the thyroid gland. It is almost invariably associated with palpitation of the heart and a prominent condition of the eyeballs, and hence have arisen the various names under which these combined symptoms have been described: as 'goître exophthalmique,' 'affection of the heart and thyroid gland,' 'anæmic exophthalmos,' 'maladie de Graves,' 'maladie de Brasedow,'—according to the theory of the origin of the disease which each writer adopts, or the name of the authors who were supposed to have first described it. It occurs more commonly in females than in males, though it is by no means confined to the former sex. The characters of the disease are very well marked, and are thus enumerated. The first symptoms are usually palpitation of the heart and habitually rapid pulse, with other signs of nervous debility; and these are followed at a longer or shorter interval by enlargement and pulsation of the thyroid gland, with violent beatings of the carotid arteries. After these symptoms have existed for some time,—and in some cases, it is said, before the enlargement of the thyroid gland,—an unnatural prominence of the eyeballs begins to be perceptible; and this gives to the patient a wild or startled, and occasionally almost maniacal expression. In a case related by Dr. Stokes,* 'the tumefaction continued to increase, until the globes of the eyes appeared to protrude from the orbits, looking downwards and forwards, and exhibiting a zone of white sclerotic round the entire of the cornea of at least two lines in breadth. The lids could only be half closed; and the appearance of this lady during sleep, with these great brilliant eyes yet open, can never be effaced from my memory.'†

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* *Lancet*, July 13, 1861.

† *Archiv. gén. de Méd.* t. xvi. 1860.

The enlargement of the thyroid gland is peculiar. In one of Dr. Begbie's cases, which may be taken as a type, it was soft, smooth, and elastic, and of equal character throughout, presenting the form of hypertrophied gland, and had rapidly developed itself to its present size—that of three or four times the magnitude of the gland in health; but it was subject to remarkable variations in this respect, according to the state of mind, rest, or palpitation. It appeared to be highly vascular, and conveyed to the touch the sensation of an erectile tumour.* There is commonly also a purring thrill to be felt by the fingers, and a loud and sometimes musical bruit to be heard through the stethoscope. Indeed, some years ago a case, in which there existed this condition of the gland, was mistaken for an aneurism, and (though fortunately for the patient the nature of the disease was discovered in time) a day had been appointed for tying the carotid artery.†

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* *Diseases of the Heart and Aorta,* 1854, p. 285.

† Dr. Stokes supposes that the prominence of the eyeballs depends on an increase in the vitreous and aqueous humours; but the majority of observers, probably more correctly, think that the prominence is caused by some morbid condition of the structures situated in the orbit, behind the globe. What this morbid state is, remains, however, still uncertain. Effusion of serum, increase of post-ocular fat and cellular tissue, congestion of the orbital veins, &c. have been assigned by different writers as causes of the protrusion.

Together with the pulsation of the thyroid gland and of its dilated main arteries, the carotids beat violently, and often with a double pulsation and loud bruit; and the patient complains of distressing sensations of suffocation, hammering in the head, vertigo, tinnitus aurium, &c. In a case recorded by Sir H. Marsh, the patient could feel the whizzing in her neck, and it formed one of her most distressing symptoms. Sometimes also the pulse in other arteries than the carotid is unusually jerking and large. In one of Dr. Stokes's cases the patient complained of violent pulsation of the abdominal aorta; and in a case which Dr. C. J. B. Williams mentioned at the Med.-Chir. Society,‡ there was enlargement of the arteries of the forehead, face, and neck. In many cases, however, a marked difference in the pulsation of the carotids and of the radial arteries has been noticed; that of the former being violent and jerking, that of the latter comparatively feeble.§ Sometimes large veins can be seen ramifying over the enlarged thyroid gland; and the external jugular and other veins of the neck are at the same time much distended. The heart beats quickly, and upon the least excitement violently; and at its base and in the large arteries a bellows-sound is almost always to be heard through a stethoscope. The pulse, indeed, habitually rapid, often reaches 130-140 beats in a minute.||

From the foregoing account it will be readily seen that this disease is very different from ordinary goître; and indeed its diagnosis from this or from any other malady is not difficult. These are the chief points of distinction from common broncho-

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* *Contributions to Practical Medicine*, 1862, p. 121.

† *Diseases of the Heart and Aorta*, by Dr. Stokes, p. 279.

‡ *Lancet*, Dec. 8, 1860.

§ Dr. Stokes, op cit.; Dr. J. O. Fletcher, *Brit. Med. Journal*, May 23, 1863.

|| Begbie, op. cit. p. 130.

cele: 1, The size of the tumour formed by the enlarged gland varies considerably with the general condition of the patient as to rest or excitement, and their effect on the heart's action; 2, the appearance of the disease is independent of endemic influences, so powerful in the production of ordinary goître; 3, the tumour rarely becomes large enough to cause any great deformity, though Dr. Stokes says he has seen two cases in which this was produced in a considerable degree; 4, Dr. Graves says that it differs also from goître in its size becoming stationary just at that period of growth at which the last-named disease usually increases more rapidly; 5, the purring thrill and loud murmur in the tumour, as well as the other general symptoms, —the palpitation, the prominent eyeballs, the jerking carotids, &c.,—will be abundantly sufficient for confirming the diagnosis.

Notwithstanding the apparent urgency of the symptoms, this disease is very rarely fatal, unless accompanied with organic disease of the heart, or some other serious complication. Comparatively few opportunities of examining the condition of the thyroid gland, after death, have therefore occurred; and these have been for the most part in those who died from some attendant malady, rather than from the peculiar assemblage of morbid symptoms which by themselves make up the disease.

The appearances, therefore, which have been observed in the heart, &c., after death, in the few cases on record, must not be taken as representing those which ordinarily exist; but must be checked by the observation of the far larger number of cases in which complete recovery has ensued on proper treatment. The appearances, however, which more immediately concern us—those in the thyroid gland, namely—are probably characteristic.

In 1841, Sir H. Marsh communicated to the Pathological Society of Dublin an account of a patient who suffered from this disease, and who died from gangrene of the extremities, preceded by erysipelas and anasarca. The thyroid gland was irregularly lobulated on the surface, the lobules or cysts containing a quantity of clear fluid. The right internal jugular vein was much dilated, and measured, when emptied by puncture, an inch and a half across. One of the enlarged lobes of the thyroid body lay over the carotid artery. Both auricles, especially the left, were much dilated. The left ventricle was somewhat dilated and hypertrophied. The auriculo-ventricular valves, on both sides, had thickened margins; the disease apparently proceeding from depositions of fatty granular matter under the membrane. The right valves were more affected than the left.* In another case, that of a woman who died from apoplexy, and who, at the time of her death, suffered from this disease, the thyroid arteries, which during life could be felt pulsating strongly, were found greatly enlarged and remarkably tortuous. The thyroid gland was enlarged. The left ventricle was greatly hypertrophied, and its cavity much dilated.* In a case of Dr. Begbie's, the thyroid gland was enlarged to three times its normal bulk from hypertrophy. The heart was somewhat enlarged, from slight dilatation of the right cavities. The walls of the right auricle were very thin. The valves were healthy. Various other organs were more or less diseased.† In another case recorded by the same author, and in which the patient died from heart-disease, general dropsy, &c. 'the sterno-hyoid and sterno-thyroid muscles were much thinner and broader than natural, from being stretched over the thyroid body, which was of large size. The external jugular veins were normal; the internal jugulars were large; the left one, when slit open, measured an inch and a half across at a level with the cricoid cartilage. The thyroid body was of large size, but was not weighed; its weight, however, might be computed at four or five times the natural weight. Each lateral lobe measured an inch and a half in breadth, and was of a corresponding thickness. This great size was not partial, but general; and although the isthmus was comparatively larger than the lateral lobes, there was complete symmetry of both sides. It was of a dusky-red colour, smooth, and well-defined, and slightly irregular on its anterior surface; but still retained the natural convex and semilunar form of the organ, when in a state of health.‡ Several other organs were diseased.

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* Stokes, op. cit. p. 290.

The prognosis in those cases—the most frequent—in which there exist no signs of grave organic disease in the heart or other organs is very favourable, though a long time often passes before the characteristic features of the disease entirely disappear. In favourable cases, the heart, becoming less excitable, again recovers its former steady and healthy action; and an improvement in the state of this organ seems to be usually the first step towards recovery.§ Then follow recession of the eyeballs within the orbit, and gradually lessening of the thyroid tumour, with loss of its pulsation, and, it may be, hardening of its substance;‖ and accompanying these are improvement in the general health, and commonly, after a longer or shorter time, perfect recovery.

The immediate causes of the disease are not very well defined; but they appear to include almost any of those circumstances which lead to general ill-health and anæmia, although in some cases the patients are tolerably healthy-looking or even plethoric. Dr. Begbie, however, thinks that even in these there is probably an unhealthy condition of the blood; and adds, 'I have seen no instance of the disease in which the general and physical signs of anæmia were not more or less completely developed, and no case in which an adequate cause of that condition was not furnished in its history; nor any one in which a marked mitigation, or complete removal of the symptoms, has not taken place under a plan of treatment calculated to overcome the blood-disorder.'* Amenorrhœa, long-continued hæmorrhage from piles, bilious diarrhœa, want of rest, and many other similar causes, have been assigned in different cases. Dr. Stokes says, 'In young women, mental anxiety and the effect of terror may produce it. I have known a remarkable instance of the latter cause inducing the disease in a lady who had previously been healthy.' In a few cases the disease appears intimately associated with organic disease of the heart; but this can be by no means considered essential, and the cardiac disease is supposed by many, when it exists, to follow rather than precede the symptoms which have been described, and to arise from long-continued functional disorder of the organ.

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* Ibid. p. 291. † Op. cit. p. 141. ‡ Op. cit. p. 146.

§ Dr. Fletcher, Dr. Stokes, &c. op. cit.

‖ Dr. Bullar, *Med.-Chir. Trans.* vol. xliv. p. 40; Dr. Stokes, op. cit. p. 288.

There has been almost as much difference of opinion concerning the nature of this disease as there has been agreement concerning its symptoms, prognosis, and treatment. Dr. Begbie thinks that the essence of the disease consists in a vitiated or impoverished condition of the blood, and that this condition, acting directly on the cardiac nerves, excites the heart and vessels to over-action; that the anæmic palpitation thus produced is followed by the characteristic symptoms, and, if not removed, issues in organic change of the heart, in enlargement of the great vessels, in induration and structural degeneration of the thyroid gland, &c. Dr. Stokes supposes that the disease is a special form of cardiac neurosis, which may lead to organic disease, and that the nervous excitement is possibly propagated to the arteries of the neck, as he thinks that their pulsation is more than can be accounted for by the force of the heart. Prof. Laycock† thinks the symptoms are due to neurosis of the cerebro-spinal tract, or rather of several vaso-motor centres in the spinal cord. The bronchocele (which is essentially a dilatation of the vessels of the thyroid gland) he thinks is due to a lesion of a paralysing kind of the trunk of the sympathetic. Dr. J. O. Fletcher is of opinion that we must look to the nervous system, and especially to the brain for the cause, and that the disease is 'hyperneuria,' induced by sleeplessness, anxiety, &c., impairing digestion and assimilation; 'secondarily interfering with the normal nutrition of the nerve-centres, causing a state of hyperneurosis with want of power, which induces imperfect secretion by some organs, and, as a necessary consequence of this, if long continued, causes organic changes.'* Dr. Handfield Jones: that the fundamental malady is debility, especially of the nervous system, which, by affecting various vaso-motor nerves, gives rise to the several symptoms.† M. Trousseau: that it is a neurosis, having its proximate cause in a change of the vaso-motor apparatus, and that the anæmia follows, rather than precedes, the characteristic symptoms.‡

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* Op. cit. p. 170.

† *Brit. and For. Med.-Chir. Rev.*, Jan. 1864.

The proper treatment is very definitely pointed out by the causes and symptoms of the disease. To remove those conditions (if they still exist) which appear to have been important elements in the first production of the disease, as hæmorrhage, over-exertion of mind or body, &c.—to allay the excessive action and irritability of the heart by digitalis, morphia, hyoscyamus, and similar drugs—to improve the impoverished or vitiated blood by tonics, especially iron—to place the patient in favourable conditions, so far as is possible, for good air and perfect rest,—are the obvious and most important general methods of treatment, the details of which must be decided separately for each case. Iodine, whether taken internally, or applied to the surface of the swollen thyroid gland, appears to be by itself of very little use. The application of ice appears in some cases to be very beneficial. It does not often happen that immediate danger is caused by the pressure of the enlarged thyroid body on the trachea; but M. Trousseau relates such a case; and the patient, a boy about 14 years old, was apparently saved from suffocation, or, at least, from undergoing tracheotomy, by venesection, by the application of ice to the neck, and by the administration internally of digitalis.§ Three weeks afterwards he could walk more than two miles, and, when M. Trousseau last saw him, he had almost completely recovered.

Dr. Graves ingeniously suggests that the globus hystericus, so commonly attendant upon nervous palpitation, and so often referred by the patient to the situation of the thyroid gland, may arise from swelling of this body and pressure on the trachea; and that it is not, therefore, a purely nervous sensation.

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* Op. cit. p. 539.

† *Proceedings of Med.-Chir. Soc.* 1861.

‡ *Clinique méd. de l'Hôtel-Dieu,* pp. 644, 645.

§ Op. cit. p. 631.

Acute inflammation of the thyroid body is rare. Sir T. Watson remarks that this gland 'does not seem very prone to inflame; and probably Dr. Copland is right in his opinion that inflammation occurs spontaneously in this organ in scrofulous persons only.'* I have met with one instance of the disease.

An old woman, incurably insane, died in Bethlehem Hospital, December 22, 1846. Before death, for some days, she had experienced great difficulty in swallowing, and had objected to take food. On examination of the body, it was found that the skull-cap was thicker and heavier than natural, and the brain was congested with blood. There was diffused purulent infiltration for one inch in length and half an inch in breadth, affecting the cellular tissue of the œsophagus just where it winds round to get in front of the descending aorta. The left lobe of the thyroid body was much enlarged, and occupied by cysts of various sizes. There was purulent infiltration diffused throughout the whole organ, but more extensive on the left side. The cysts contained flakes of thick fibrine mixed with fœtid fluid. The œsophagus was contracted in that spot around which the pus had been effused. There was no other morbid appearance.

Mr. Turner, of Kensington, has related some cases of *suppurating cysts* of the thyroid body, treated by free incision; in one case the cyst-wall came away, and, reasoning from this experience, he proposed, as a method of treatment, to obliterate the cysts formed in this gland by inflammation artificially excited in the following manner. The skin covering the cysts was gradually destroyed by repeated applications of caustic potash rubbed over a space equal in size to a florin; then a blunt-pointed director was introduced, and pushed about so as to excite vascular action, in consequence of which suppuration ensued, and the cavity slowly contracted. He put this method into practice in two cases, the particulars of which are related in the *Medical Times and Gazette*, Jan. 20, 1855. We must accord merit to this surgeon for the care with which he conducted his cases.

In 1841, the late Mr. Vincent had under his care, in St. Bartholomew's Hospital, a woman, 48 years old, with a tumour in front of the neck, as large as the head of a child of two years. The tumour contained fluid, which was twice withdrawn with a trocar. The fluid first evacuated resembled serum, but coagulated spontaneously; on the second occasion it was mixed with blood. After the second operation, the cyst inflamed, and discharged grumous and sanious pus; but it also enlarged quickly, and the patient died unexpectedly from suffocation. On examination after death, it was found that nearly the whole of the right lobe of the thyroid body was occupied by a cyst, the walls of which were two lines in thickness; the cavity was full of lymph, pus, and blood; the sudden death was due to a discharge of a great part of its contents into the pharynx and larynx, through an ulcerated aperture into the former.*

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* *Lect. Practice of Physic,* vol. i. p. 756, 1845.

In reference to this subject Flajani says:—

> 'I was once called to assist a gentleman, 40 years of age, brought to death's door by a bleeding, which arose from the application of caustic to the fore part of the neck. As tourniquets, bandages, &c., proved quite ineffectual, it was indispensable to make pressure on the part with the finger of an assistant for twenty-four hours, ere the hæmorrhage could be stopped; a copious suppuration ensued, and it was three months before the part healed. I was likewise present,' says he, 'at the opening of a similar but larger swelling in the same situation, the patient being an elderly person, who had suffered from the disease for several years. The incision caused the evacuation of a small quantity of serum, contained in the cellular membrane; but the following day the tumour inflamed, the difficulty of respiration increased, and for some days the patient was in great danger. At length suppuration was established, followed by destruction of a great deal of the cellular membrane and several sinuses. The patient lost his life; and on examination of the body, the lungs were found tuberculated; an effect of the impediment to the circulation of the blood through the smaller vessels of those organs.'†

I have succeeded in producing the complete obliteration of a thyroid cyst, with corresponding diminution in the size of the swelling of the gland, in a young married woman, healthy, and of temperate habits, by means of the injection of iodine in the usual proportions of one drachm of the tincture to five of water. But whoever undertakes such an operation should bear in mind the numerous complications which may await him; as well as the fact that in some instances the hæmorrhage has been so severe as to demand the application of a ligature to the carotid artery.

Two cases of *cancer* of the thyroid body have been recorded by Dr. v. Franque.‡ Both patients were between forty and fifty years of age, and in both instances there was found further morbid deposit in various organs. In the left lung of the first case there were noticed old tubercle in the upper lobe, and cancerous deposit in the other parts. In the second case the viscera were very generally affected.

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* Museum of St. Bartholomew's Hospital, ser. xxii. No. 16.

† Flajani, *Collezione d' Osserv.* t. iii. p. 283, 8vo, Roma, 1802.

‡ *Deutsche Klin.* vol. xxxix. 1856.

The same disease has been described by Mr. Cæsar Hawkins in the *Medical Gazette*, 1843. The first case, seen in 1837, might perhaps be somewhat doubtful, from want of post-mortem examination; but four other cases were verified. The disease commenced between the ages of forty-five and sixty. In one instance the parts adjacent to the pharynx and œsophagus were infiltrated by cancer. There was a large ulcer on the œsophagus, and the right internal jugular vein was closely adherent to the tumour. I have seen a similar case in St. Bartholomew's Hospital.

In such cases none but palliative remedies are of any avail; but the pain and distress in breathing may be greatly allayed by the employment of the hypodermic injection of morphine.

In conclusion, I may repeat the words of Rokitansky: 'If we except serous, fibrous, cartilaginous, and bone-like productions, all other new formations in the thyroid gland are extremely rare. Tubercle is scarcely ever seen, and cancer in its medullary form is in the highest degree exceptional.' *

HOLMES COOTE.

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* *Pathol. Anat.* vol. iii. p. 151.

DISEASES OF THE SKIN.

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PART I.

General or Constitutional Affections.

EVERY deviation from the healthy structure, function, or colour of any one anatomical element of the skin is a disease of the skin; and all abnormal states of the hair and nails are properly ranked in the same category, because the hair is formed by one of the integral parts of the skin, and the nails are a modification of the epithelium.

The majority of the diseases of the skin are secondary to constitutional derangements; in some, however, the latter are comparatively trifling, while in others the external local disease is an insignificant part of a grave illness. Special writers have usually classed some of these grave constitutional diseases among diseases of the skin; it seems, however, undesirable to describe under this head the acute specific diseases.

In other diseases of the skin, again, the subcutaneous tissues are so deeply involved, that the skin-affection constitutes a very small part of the local disease, and the propriety of classing such affections with ordinary skin-diseases is more than questionable. The same is true in regard of certain diseases attended with deviations from the healthy functions of the skin; as for example, local perspiration, the result of disease of the nervous system.

Diseases of the skin are often treated of as special affections but diseases of the skin no more constitute a special department of medicine than do diseases of the heart, lungs, or liver. Like diseases of all other organs, diseases of the skin are disposed to by certain constitutional states, and by diseases of other parts; and like all other organs, the skin, when extensively diseased, leads, perhaps through the medium of the blood, to abnormal conditions of parts not anatomically related to it. Diseases of the skin do not differ essentially from diseases of other organs: they owe their origin to the same kind of causes, they agree with them pathologically, they run a similar course, and they have like terminations. In regard of general pathology, of general etiology, and of general therapeutics, diseases of the skin are by no means special. In reference to the majority of diseases of the skin, as in reference to other diseases, we have to consider the constitutional state that disposes to the affection, the local condition that renders the skin susceptible of the special disease, and the locally-acting cause which determines the occurrence of the disease; and each of these subjects requires to be kept in view when treating the disease, and when (a point of great moment in reference to diseases of the external surface of the body) determining the proper measures to be adopted in order to prevent a recurrence of the disease.

The division of diseases of the skin into genera and species, and the best modes of grouping these in classes, have occupied a great deal of the attention of dermatologists.

No doubt, theoretically considered, the best and primary division of diseases of the skin is into essentially local diseases and essentially constitutional diseases. And this division would be practically the best, if all diseases of the skin could be arranged under the one or the other head; because, by the position assigned to any particular disease, its most important pathological character would then be at once known, and also the most important point to be kept in view in its treatment. But this arrangement is impracticable. Our knowledge of diseases of the skin is not precise enough for all to be referred severally to the one or the other of these heads.

Itch is essentially a local disease, and small-pox a constitutional affection; but where shall miliaria be placed, seeing that the miliary eruption is excited by some abnormal conditions of the perspiration, *e.g.* such as occurs in rheumatism? Again, where shall urticaria be grouped? Urticaria is sometimes excited by certain articles of diet; that is to say, during the digestion of these articles a material enters the blood, or the blood is so modified as to excite the disease of the skin called urticaria. Now, does the fact of the blood being contaminated in this way from the food constitute a claim for urticaria to be ranked as a constitutional affection? It manifestly does so. But then the application of certain irritants to the skin produces a disease identical anatomically with that induced by the ingestion of the substances just adverted to. So that urticaria may be a purely local affection, or merely the local manifestation of a constitutional state. The inconvenience of separating two cases of what is one genus when considered anatomically, is manifest. If the diseases of the skin of parasitic origin, and those induced by the external application of direct irritants, be excluded, there are very few which are not more or less dependent on constitutional derangement. Even parasitic diseases seem to take little hold on the constitutionally sound; and many of those primarily excited by local irritants are kept up by constitutional abnormities.

A second method of dividing skin-diseases into orders is founded on the supposed pathological nature of the local affection, *e.g.* inflammation, hypertrophy, the orders thus formed being divided into genera according to the structure supposed to be first affected, *e.g.* the sudoriferous ducts, the sebaceous follicles, the hair-follicles, the epithelium. But the fact is, that medical knowledge is not yet sufficiently advanced to enable us to determine in the *majority* of cases either the primary pathological process or the part of the skin, anatomically considered, first affected. So that this division, which when first proposed to us charms by its appearance of scientific accuracy, is in the present state of medicine practically impossible. The time may come when it will be as useful as it is theoretically pleasing, but to-day is not that time.

A third division of skin-diseases, and that which will be adopted in this article, is substantially that originally proposed by Plenck of Baden, and adopted with some modification by Willan, and subsequently employed by a large number of writers on the subject. At the same time I shall deviate from Willan's arrangement widely in one or two important particulars. The microscope, by revealing the presence of parasitic plants in certain of the diseases of the skin, and the close study of these same diseases, by which the relation between the plant and the disease has been ascertained, enable us to found a new order, and so, by abstracting certain diseases from some of the genera of Willan, to render those genera infinitely more natural.

The faults in principle of Willan's arrangement are many and obvious; but then it is eminently practical. The diseases grouped together in his arrangement by no means agree pathologically; but then his divisions greatly facilitate diagnosis;

they enable the name of a particular case of disease to be learned, and that being learned, its pathological and anatomical position may subsequently be determined.

Exanthemata.—The diseases of the first group have, as their great characteristic, redness, disappearing or diminishing transiently on pressure. The cutaneous affection is essentially nothing more than an increased quantity of blood in the vessels of a portion of the skin: no vesicles, no pustules, no scales, no elevation of the cutis are present. Now and then, however, the blood accumulates in such quantity at particular points as to cause a little elevation of the cutis; and if these points are small and circular, we have an appearance of papulæ; but the elevation, like the redness, disappears on pressure; to return, however, when the pressure is removed. True papulæ cannot be removed for an instant by pressure.

The connection between the hyperæmic cutis and the cuticle covering it is usually diminished either before or during the stage of resolution; and the consequence is, that there is generally a little desquamation of the cuticle while the rash is fading, or after the redness has disappeared. It is highly probable that the loosening of the cuticle is due to the effusion of a small quantity of serosity from the engorged vessels of the surface of the cutis. Now and then fluid is effused in sufficient quantity to raise the cuticle from the cutis: thus in the eruption of scarlet fever it is very common to find innumerable vesicles stud the red surface; and in erysipelas the cuticle is occasionally elevated into bullæ. The diseases characterised by red patches disappearing under pressure constitute the order exanthemata: these diseases are erythema, roseola, urticaria.

Hæmorrhagia.—In the exanthemata the blood is within the vessels of the red part; in the order hæmorrhagia the blood escapes from its vessels into the substance of the cutis, and so crimson spots unaffected by pressure are formed. There are only two diseases thus distinguished, viz. purpura and scurvy. But hæmorrhage into the substance of the cutis occurs, and not unfrequently, in the course of all diseases of low type. If the hæmorrhagic spots be small, they are termed petechiæ; if large, vibices or ecchymoses. When small, the spots formed by cuticular hæmorrhage are usually circular; at the bend of the elbow, however, they are oval. When large, they are often very irregular in form.

Vesiculæ.—The third group is characterised by vesicles, *i.e.* by minute collections of serous fluid seated immediately under the cuticle. Although at first transparent, this fluid ordinarily becomes in a short time opalescent, milky, or even puriform. The cuticle covering it is also at first quite transparent; after a while, however, it, like the fluid beneath, grows white and opaque. This change in the cuticle may precede that in the contents of the vesicle. The fluid of a vesicle is formed on the surface of the cutis, directly beneath the cuticle. The fluid from a vesicle may be absorbed, or it may dry up and form with the cuticle over it a thin scale; this scale may be detached, or it may remain attached and be thickened by fresh secretion beneath it.

If the vesicles are very small and numerous, and the fluid in them contains but little solid matter, then a mere furfuraceous desquamation follows the absorption of their contents, their bursting, or their desiccation; under these circumstances the vesicular nature of the disease may be overlooked, and the desquamation of the cuticle only noticed.

If the fluid contains a large amount of solid matters, or if the scales first formed be thickened by the drying on them of fresh secretion, then flat scabs of a yellowish-brown colour are formed. These scabs are often raised at the circumference. Dry or moist honey-like scabs are never formed by the drying-up of vesicles.

It has been said that vesicles are formed at the orifice of sudoriferous ducts; but, although this may be true in some cases, all vesicles are not so constituted. The diseases or genera of the order vesiculæ are—sudamina, miliaria, eczema, and herpes.

Bullæ.—The diseases belonging to the fourth order of skin-diseases are distinguished by the eruption of bullæ; that is to say, by collections of serosity of considerable size, situated directly beneath the cuticle, and raising the cuticle from the cutis. Bullæ differ from vesicles only in size; they vary in diameter from a quarter of an inch to two inches. Now and then the blebs, as they are called, attain the dimensions of half a hen's egg. The fluid of bullæ, like that of vesicles, as well as the cuticle over them, may be transparent or opalescent. Bullæ may be followed by crusts or by ulcerations. Pemphigus and rupia are the only two diseases belonging to this order.

Pustulæ.—The presence of pustules marks the fifth order. Pustules contain pus from the moment of their formation. The inflammation, on which the formation of pus depends, extends some depth into the cutis; so that the collection of pus which constitutes the pustule is situated in the cutis and not merely on it immediately beneath the cuticle.

When vesicles become opalescent, the opalescence depends on the presence of pus-corpuscles and molecular granules; but true vesicles, whether their contents be transparent or milky, are never sunk into the cutis, and the pus-corpuscles when present constitute a very small proportion of the contents of the vesicle.

Pustules are followed by thick and dry or by honey-like crusts.

There are three forms of pustules—viz. psydraciæ, phlyzaciæ, and achores.

Psydraciæ are very little raised above the level of the cutis. They are seated in the hair-follicles—a hair passing through the centre of each pustule. The redness around this variety of pustule is frequently very trifling, especially when the pustules are placed at some distance from each other; when near together, however, the skin between may be red, hot, and swollen.

Phlyzaciæ are distinct pustules of some size, seated on elevated, inflamed bases. They are found especially on the trunk and extremities, and they terminate in small brown scabs.

Achores are very small pustules on comparatively large inflamed bases; base and collection of pus, however, form together only a small pustule. Achores are formed in considerable numbers in the vicinity of each other, the cutis between being red, hot, and swollen. They are more common on the faces of children than elsewhere. The secretion from them forms those very large, thick, irregular-shaped scabs, resembling dried honey in consistence, so common on the chins of children. Achores are inflamed hair and sebaceous follicles.

Impetigo, ecthyma, equinia, and variola, are the genera in the order pustulæ.

Parasitæ.—The diseases of the skin in which a vegetable parasite is invariably present are tinea tonsurans, tinea favosa, tinea sycosis, and chloasma. Tinea decalvans is also placed in this group.

There is only one disease characterised by the presence of an animal parasite, viz. scabies.

Papulæ.—Papulæ are solid elevations of the cutis of small size, papilliform; their colour varies from dull white to bright red. When red, the colour may be removed for an instant by pressure, but the elevation remains. Papulæ are supposed by some to be enlarged papillæ; but the researches of Gustav Simon prove that papulæ may be formed at any point of the cutis by infiltration of the cutis at that point with serosity.

Three genera belong to the order papulæ, viz. strophulus, lichen, and prurigo.

Squamæ.—The order squamæ is characterised by the formation of an excessive quantity of epithelium-scales loosely attached to each other and to the cutis. By the slightest friction dry opaque white scales are detached from the diseased surface.

Psoriasis and pityriasis are the only two genera of the order squamæ.

Tubercula.—Solid hard elevations of the cutis, much larger than papulæ, are called tubercula. In this order are included several diseases anatomically and pathologically very different from each other. The order tubercula includes molluscum, acne, lupus, elephantiasis, frambœsia, keloid, and cancer.

Maculæ.—The diseases of the order maculæ are characterised by the presence of too much or too little pigment in the parts of the skin affected, and therefore by white or dark-coloured spots. They are lentigo, ephelis, vitiligo, and nigrities.

Xerodermata.—The order xerodermata is characterised by roughness, dryness, and loss of elasticity of the skin, without desquamation of the cuticle or any eruption. Ichthyosis and xeroderma (Wilson) are the diseases which constitute this order.

As each order of skin-diseases is divided into genera, so each genus is divided into species. The species of some genera differ from each other most decidedly both anatomically and pathologically. Some species, again, are anatomically almost identical, although, pathologically considered, they are very different; while others, although very different in aspect, are pathologically alike. The specific name usually indicates some striking peculiarity of the disease; in some cases a peculiarity in the constitutional state, as in rubeola maligna, roseola variolosa; in some, a peculiarity in the local symptoms, *e.g.*

rubeola sine catarrho; in some, in the form of the eruption, *e.g.* roseola annulata, erythema circinnatum; in others, in the time of the year at which they are supposed to prevail, *e.g.* roseola æstiva, roseola autumnalis; in others, in the seat, *e.g.* herpes labialis, herpes præputialis; in others, in the duration, pemphigus diutinus; in others, in the number of the spots, pemphigus solitarius; in others, in the colour of the eruption, *e.g.* strophulus albidus; in others, in the sensation of the patient, *e.g.* prurigo formicans.

In the great majority of instances the specific name is a useless burden to the memory, at the same time it confuses the mind of the student. It is therefore greatly to be regretted that so many physicians who have made disease of the skin a more or less special study, have introduced, on the most insignificant foundations, new generic and specific names for well-described, and not badly-named diseases.

EXANTHEMATA.

Roseola is an acute disease, of trifling importance so far as concerns the safety or the suffering of the patient.

Roseola is so named from its colour. It is characterised by small rose-coloured spots, or by a roseate mottling of the skin. The spots are slightly raised above the level of the adjacent skin.

All varieties of roseola have a purely constitutional origin. There is one variety very common in children and young persons of both sexes (hence called by some R. infantilis), and especially prevalent in hot weather (and therefore named R. æstiva), in which rose-coloured spots and mottling give to the skin an appearance very closely resembling that of measles. From the rash of measles that of roseola æstiva differs, in the absence of a crescentic form or arrangement of the spots,—a character very rarely indeed wanting in measles; in the very irregular shape of the patches, and in their more rosy and generally paler hue; in their commencing on the most prominent parts of the face and extremities, instead of, as in measles, about the edge of the hairy scalp; in their limitation not uncommonly to a small part of the trunk, or to a single limb; and in their irregular course.

Trifling febrile disturbance usually precedes the rash for a few hours, or it may be a day or two, and dryness and redness of the fauces are common. The coryza, so distinctive of measles, is never observed in roseola æstiva. A measles-like rash, accompanied by sore-throat, and without coryza, should suggest the possibility of the case being roseola æstiva. If more than one child in the same family is affected, the probability is in favour of the disease being measles; but the writer has seen two sisters, after an error in diet, affected at the same time with well-marked roseola æstiva. Sometimes those of the greatest experience will be in doubt whether the case be one of roseola æstiva or of measles.

The duration of roseola æstiva is by no means constant. The rash may disappear in twenty-four hours, or it may remain out for four or five days. Occasionally it appears again after having once vanished. This form of roseola occasionally occurs as an epidemic. It is the disease to which the name bastard measles has of late years been applied.

A rose-coloured rash, very similar to that of roseola æstiva, sometimes precedes the eruption of small-pox. It occurs especially at the flexures of the joints. The pain in the head and back, and the vomiting, which precede the eruption, indicate the nature of the case, as no such symptoms precede the rash in any other form of roseola. Sometimes this variety of roseola bears a close resemblance to the rash of scarlet fever.

A similar rash may accompany vaccinia, gout, and rheumatism; it may under these circumstances cover more or less of the trunk and extremities, or it may occur in patches. The specific name is derived from the constitutional disease to which the roseola is secondary, *e.g.* roseola variolosa, roseola vaccina, roseola rheumatica. The remaining two varieties of roseola differ altogether in appearance from roseola æstiva. Now and then in adults, as well as children, and more commonly on the arms than elsewhere, a few rose-coloured circular spots are seen, varying in size from a threepenny-piece to a shilling. These spots are not elevated, or only very slightly so, and their colour disappears on pressure. As this affection has been thought to be more common in the autumn than at any other period of the year—though its especial prevalence at that time of year is doubtful—it has been called roseola autumnalis. It is a disease of no importance, and may not be accompanied by any general or internal local derangement, though occasionally there is a little febrile disturbance, or some dyspepsia. It rarely lasts more than a week or ten days. On the lower extremities, and sometimes on other parts, we observe several rose-coloured rings, varying in diameter from a quarter of an inch to an inch. The colour of the skin within the rings is quite natural. The rose-red colour is the only deviation of the skin from its healthy state. This form of roseola is named roseola annulata. Like roseola autumnalis, it is usually accompanied by a little febrile disturbance, and runs its course in a few days. Now and then, however, it is a chronic disease, lasting for many weeks.

Treatment.—A warm bath or two—rest—simple diet—and a single dose of mercurial at bedtime, followed by a mild saline alkaline aperient the following morning, is usually all that is required in the treatment of a case of roseola. Roseola infantilis is sometimes the consequence of painful dentition; should the gums be hot and swollen, they ought to be scarified. In the chronic form of roseola annulata, the digestive organs are commonly much deranged, and the patient more or less generally out of health. Change of air—mild tonics, such as the mineral acids—and sea-bathing—are the best remedies. At the same time care must be taken to regulate the patient's diet. As the dyspepsia is of the atonic form, a glass or two of wine daily is usually of advantage. As this disease is sometimes dependent on uterine disturbance, the condition of the uterine and vaginal discharges should be ascertained.

The eruptions proper to typhus fever, measles, typhoid fever, scarlet fever, and cholera are in reality roseola, but differ in important particulars from the varieties just described. The rash of typhus and of measles as much merits the name of roseola as does that which precedes the eruption of small-pox. The mulberry rash of typhus fever differs from the other varieties of roseola by its dusky colour and the petechial character assumed by the separate spots as the disease progresses—the exanthem of typhoid fever by the wide separation of its constituent spots from each other, and the papular form of the spots; that of measles by the crescentic arrangement of its spots; the rash of scarlet fever by its punctiform character, its colour, and the extent of surface covered; that of cholera by the size and irregular form of its spots and their tint. All are distinguished by their course, and by the constitutional disturbance which precedes and accompanies them.

Erythema is characterised by patches of redness of irregular form, and of rather large size, often somewhat raised above the level of the adjacent skin. When at its height the colour of the patch is vivid red; before disappearing the patch assumes a bluish hue. Pathologically considered, there are two distinct kinds of erythema, one having a local, the other a constitutional origin.

Varieties of erythema of local origin.—When two folds of the skin overlap each other, the secretions accumulate and the two surfaces chafe each other; inflammation of the skin is the consequence—intertrigo, or erythema intertrigo, as it is called—a disease very common in the groins and necks of young children and fat women. A little moisture exudes from the inflamed surface.

The inflammation of the skin resulting from a burn is one variety of erythema. That peculiar inflammation of the skin which we call a chilblain, is, when dignified by a scientific name, erythema pernio. When the skin stretched over an œdematous part inflames, as often happens, the disease is erythema læve. If the patient lies long on one spot, and the skin over it inflames, it is erythema.

Chronic local erythema is pretty common on the face, around the lips, and on the buttocks of young children. The skin when inflamed about the lips, the orifice of the vagina, the prepuce, the groins, and the anus, is peculiarly liable to crack.

Intertrigo is best treated by frequent ablution, bathing the inflamed surface with an astringent wash,—a solution of acetate of lead is one of the best,—and then, after carefully drying the part, dusting it with an absorbent powder, such as starch, or oxide of zinc. It is important to bear in mind, with reference to erythema læve, that the inflammation of the skin increases the œdema of the subcutaneous tissue. If, as is usually the case, it is the lower extremities which are the seat of erythema læve, they should be raised, to favour not only the return of blood from the limbs, but also the draining of the serosity out of the tissue, the skin covering which is inflamed. A few punctures in the thigh with a fine needle, by permitting the escape of serosity from the cellular tissue, will aid the cure of the erythema. If the œdema be not reduced, bullæ sometimes form on the erythematous surface, and finally the skin ulcerates or even sloughs. As to the erythema from pressure, that is best treated by careful drying of the part after washing, the application several times a day of spirit of wine, or an astringent solution, as alum; but above all, by the greatest attention to cleanliness and frequent change of position. A sore back from pressure very rarely occurs in fever or paraplegia, the diseases in which it is most common, if the patient be well nursed.

Varieties of erythema of constitutional origin: E. fugax, E. papulatum, E. nodosum, E. circinnatum (syn. *annulatum*), *E. tuberculatum, E. marginatum.*—The local disease in these varieties of erythema, although characterised by redness, &c., hardly merits the name of inflammation, unless we give to that vague word a very wide signification. All these varieties of erythema are more common in those disposed to rheumatism.

Erythema fugax is distinguished by the sudden appearance of large red patches, and their equally sudden disappearance after a time varying from a few minutes to a few hours. The patches of erythema fugax are more common on the face than elsewhere; not infrequent on the trunk; rather rare on the extremities. The usual cause of erythema fugax is some article of diet. The patches disappear in less than half-an-hour. That erythema fugax results in some cases from nervous influence is rendered probable by such facts as this: a gentleman known to the writer cannot even think of heating condiments without experiencing a sensation of heat in the face, forehead, and scalp, conjoined with some redness of the part.

Erythema nodosum is a common affection in girls from six to twelve years of age, and not very rare in delicate boys and adult females, characterised by the eruption of distinctly elevated red patches of an oval, or more rarely circular, form. The oval patches are from one to two inches in length, the circular from half an inch to an inch in diameter. Each patch lasts from four to ten days; fresh patches appearing every day or two. The disease is commonly finished in a fortnight or three weeks. In persons past the middle of life it occasionally lasts for months. Each patch runs an acute course, but fresh patches come out every few days.

On their first appearance the colour of the patches is tolerably bright red; but when about to fade, the patches assume a bluish or violet tint. Exposure to cold also gives to the erythematous patch the same hue. This bluish colour is very characteristic of erythema. Over the anterior aspect of the tibia, which is the ordinary seat of erythema nodosum, the patches are commonly oval, their long axis being from above downwards; about the knee-joint, and at the back of the leg, they are usually circular. On the upper extremity, where they appear in rare cases only, they are also circular. The oval patches are from three-quarters of an inch to two inches in length, the circular patches from half an inch to one inch in diameter. They are rarely seen on the lower extremities much above the knee, nor on the upper extremities above the elbow. It is very rare for patches to occur on the trunk.

Occasionally, several patches are evolved in the vicinity of each other; and their margins coalescing, a broad red patch is formed, here and there hard, elevated, and very tender. The redness of erysipelas terminates by a well-defined line; in all other forms of erythema it shades off into the hue of the adjacent skin. The margin of an erysipelatous patch is as much raised as its centre; the elevation of a patch of erythema nodosum ceases by degrees with the redness. When the finger is passed over a patch of erythema nodosum, it feels as though the hardness were caused by something buried under as well as in the skin. Erysipelatous hardness is brawny in character and superficial. When several patches of erythema nodosum are present, the disease can hardly be confounded with erysipelas. The largest patches of erythema nodosum now and then convey to the finger a sensation of fluctuation; but they never suppurate, and the sensation of fluctuation is probably due to the presence of serosity in the subcutaneous cellular tissue.

Erythema tuberculatum and *papulatum.*—When patches, agreeing in other points with those just described as characteristic of erythema nodosum, do not exceed a fourpenny-piece in size, the disease is called erythema tuberculatum; when not larger than a very small split-pea, the disease is called erythema papulatum. Sometimes circumscribed patches of a bright red colour, studded with deeper-coloured points, which to the eye resemble papulæ, but are without the elevation and hardness of true papulæ, appear on the arms, neck, and breast; the colour and slight elevation are both temporarily removable by the pressure of the finger. To these patches also the term erythema papulatum has been applied.

Erythema circinnatum is not a very common disease. It affects children and adults, and ordinarily supervenes in the course of an attack of acute rheumatism. Its usual seat is the trunk.

The patches are ring-shaped. Sometimes, however, the rings are imperfect: and not infrequently several rings coalesce at their margins. The rings are red, distinctly raised, terminate abruptly externally, both as regards their colour and elevation, but shade off gradually towards the centre. Within the ring the skin has a faintly yellowish tint. The breadth of the red ring is about one-third of an inch. The patches are quite smooth; there is not a trace of scales, vesicles, or scabs on their surfaces. The colour of the rings of roseola annulata is darker than that of erythema circinnatum, the elevation is scarcely perceptible, the outer margin is not abrupt, and the centre is the colour of the natural skin, instead of yellowish. Erythema circinnatum, when acute, runs its course in about a fortnight or three weeks. There is a chronic variety, however, in which the rings are incomplete, and to it the name of erythema marginatum has been applied. Willan mentions that it occurs on the extremities and loins of aged persons suffering from internal disorders, and that its occurrence is an unfavourable sign.

Hebra considers E. tuberculatum, papulatum, circinnatum, and a species from its form called gyratum, to be merely stages of the same species and for this species proposes the term Erythema multiforme.

A little desquamation of the cuticle covering the red patches follows the disappearance of all the varieties of erythema and roseola. The eruption of roseola itches slightly; that of erythema usually itches, burns, or tingles in a trifling degree.

It is evident that there is little or no essential difference between roseola and erythema; and that, excluding inflammation of the skin, dependent altogether on local causes, that variety of roseola which so closely resembles measles and erythema nodosum, the other varieties of roseola and erythema might well be grouped together into one genus, and this whether regard be had to their local or general pathology, or to their treatment.

A few warm baths, rest, mild aperients, simple salines, and a light diet, so long as the skin is hot, the pulse quick, and the tongue white; attention to the digestive organs, mineral acids, and vegetable tonics, after the febrile disturbance has ceased,—these are the remedies for all. Erythema nodosum, tuberculatum, and papulatum, and the chronic variety of erythema circinnatum, usually occur in delicate persons; and in their treatment quinine is said to be particularly useful. Dr. A. Todd Thompson, whose remarks on treatment are always worthy of attention, found bark in many cases much more beneficial than quinine. In women past the middle of life, the eruption of erythema nodosum is thought to be connected with the cessation of the menstrual discharge. Erythema circinnatum occurring in the course of acute rheumatism disappears spontaneously.

The pathology and etiology of *urticaria*, or nettle-rash, are so very closely related to erythema fugax, and the two so often occur in the same individual, that we pass naturally from the genus erythema to urticaria. Yet urticaria is not correctly placed among the exanthemata. In urticaria there is something more than redness disappearing or fading on pressure; there are wheals, or pomphi, as they have been called.

Wheals are flat elevated patches of the skin. The sting of a nettle, the bite of a bug, the stroke of a whip, are each followed by a wheal. Wheals differ much in form, size, and colour. In form they may be circular, oval, or irregular; in size, they vary from two lines to some inches in length; in colour, from almost white to deep purple.

In urticaria each wheal is seated on a red patch; sometimes the patch is very large, the wheals small; sometimes the redness forms merely a narrow halo around the wheal; several wheals may be seated on the same red patch. Wheals frequently appear and disappear again with singular rapidity. Now and then the red patches remain for a while after the wheals have vanished; in some cases the red patch precedes the eruption of the wheal, in others the wheal comes out first; while in others, again, they appear simultaneously. When the red patch only is present, the disease may be very readily confounded with erythema; a little friction of the part, however, will prevent the mistake by bringing out the wheal. Now and then the surface covered by the redness is very considerable in extent, and then the wheals not being present, the case might possibly be taken for scarlatina. There may usually be detected on the red parts one or two wheals imperfectly evolved, which will reveal the true nature of the case.

Patients often mistake the pale elevations of the cutis for blebs, and say that large blisters occasionally come out over them. The wheals in urticariá itch, tingle, and burn. These sensations are often almost intolerable. Usually they are aggravated at night when the patient is warm in bed, when seated by a fire, and by the use of stimulating articles of diet. Now and then, however, the wheals and the itching, tingling, and burning sensations are only present when the patient is exposed to cold. Any change of temperature suffices in some cases to determine the evolution of the wheals. The structure of the wheals in urticaria has not been very clearly made out. The redness is, of course, caused by repletion of the vessels of the cutis; but to what is the elevation and pallor of the wheals due? Gustav Simon says that if a needle be passed into the cutis constituting a pale wheal, a little clear serosity only escapes; and he concludes from this that the swelling is occasioned by the presence of serosity in the substance of the cutis. The pallor is attributed to the quantity of serosity effused being out of proportion to the number of vessels loaded with blood. The sudden appearance and disappearance of the wheals seem, however, to be opposed to these ideas.

Urticaria is a very common disease. It occurs at all ages. Persons prone to rheumatism are especially liable to urticaria.

Varieties of urticaria.—Local urticaria results from the application to the skin of certain irritants, *e.g.* a blow, a sting, &c.

Acute varieties.—A most acute and severe form of urticaria is not unfrequently the result of a single error in diet. In some persons shell-fish, in others pork, in others pastry, in others the more common articles of diet, as eggs or sugar, produce an attack of urticaria, and this although the food be the best of its kind. In some persons an attack of urticaria only occasionally follows the use of particular substances; in others, it is the invariable consequence. The patient is said to be poisoned by what he has taken. An attack of urticaria having such an origin usually terminates in two or three days. The eruption may appear very rapidly after the ingestion of the noxious substance. It not unfrequently occurs within an hour. The eruption may disappear in a few hours. As a rule, the sooner after the ingestion of the noxious agent the symptoms appear, the more quickly do they disappear. Mr. B. Squire has seen cases of acute urticaria due altogether to the presence of the *acarus scabiei* in the epidermis.

An acute attack of urticaria sometimes occurs without the patient having committed any error in diet. It is then generally preceded for a day or two by some febrile disturbance. There are no special symptoms present in these cases to indicate that the pyrexia is only the prelude of an attack of nettle-rash.

The eruption of the wheals is the first intimation of the exact nature of the disease. This variety of urticaria ordinarily lasts a week. It is termed U. febrilis.

Treatment.—When acute urticaria arises from the patient having eaten some substance which he has imperfectly digested, an emetic, followed by a mercurial and saline aperient, is generally all that is necessary for the cure. If there be much depression at the outset, it may be necessary to give a little ammonia; or, on the other hand, if the febrile disturbance be great, to take a little blood from the arm.

Chronic varieties.—More frequently urticaria is a chronic disease, and it may then last for years. Sometimes the wheals are confluent, or almost so, and then the disease is called urticaria conferta. Occasionally, even in comparatively chronic cases, the wheals that first appear remain out till the patient is permanently well. Urticaria in which the wheals are thus permanent is called urticaria perstans. Far more commonly the wheals come out in crops, so to say, which last only a few hours, fresh crops appearing with every change of temperature, with every abnormity of diet, or on the slightest friction. Now and then not a wheal appears for a week or two, and then a fresh crop comes out. Urticaria, characterised by these evanescent wheals, is urticaria evanida. In rare cases the wheals attain a very large size, and then the disease is urticaria tuberosa; in still rarer cases the patient suffers from the burning, itching, and tingling sensations in numerous parts where no wheals appear, and then Willan called the disease urticaria subcutanea. In regard of the species of urticaria, all the important points may be summed up thus: the disease is now and then a very acute disease, distinctly referrible to an error in diet; now and then an acute disease not referrible to error in diet; more often the disease is chronic, the wheals appearing and disappearing rapidly on the slightest cause, or even without any known cause.

In the *treatment of the chronic forms of urticaria* especial attention is to be paid to the patient's diet. In some cases abstinence from coffee, in some from tea, in some from milk, in some from porter, in others from the water they were drinking, has been followed by recovery. I know a young lady who always suffers from urticaria when she resides in a particular locality, from the quality, it seems to me, either of the air or water at that spot; and she informed me that many persons in the same village suffer from the disease. While residing there, medicine has little effect on the disease; when she leaves that village, no medicine is required for her cure.

After regulating the diet, a mild course of antacid saline aperients is often useful. In other cases saline aperients, combined with a bitter infusion and a mineral acid, seem to be the most efficacious remedies.

A course of cold sea-baths is sometimes followed by recovery when other means have failed. If the patient is plethoric, and the pulse is full and hard, a single blood-letting, to a moderate extent, affords much relief. In obstinate cases arsenic in small doses—as three minims of liquor potassæ arsenitis three times a day—continued for some time, has effected a cure. Some physicians attach much importance in the treatment of urticaria to quinine, in doses of two or three grains three times a day. Colchicum is with others a favourite remedy. Carbonate of potash or liquor potassæ, with a bitter infusion, three times a day, is sometimes useful, by correcting deranged conditions of the stomach.

The disease may often be kept in abeyance, the eruption of fresh wheals be prevented, and the irritation of those present be allayed, by sponging the whole surface night and morning with lemon-juice or vinegar. Mr. Wilson speaks very highly, for the latter purpose, of a lotion composed of bichloride of mercury, from five to ten grains, spirits of rosemary and spirits of wine of each one ounce, and six ounces of the emulsion of bitter almonds.

If a child suffering from urticaria be cutting its teeth, and the gums are hot, dry, and tender, they should be lanced. A single dose of calomel and jalap usually suffices to cure the disease in the young child.

HÆMORRHAGIA.

Purpura is characterised by an eruption of spots (called petechiæ) or patches (called vibices or ecchymoses), both due to hæmorrhage into the derma, varying in tint from bright-red to violet. In diameter they are less than a line to more than an inch; the smallest spots are round, the larger more irregular in shape. At first the spots have an abrupt well-defined margin; but after a time their outline is gradually lost in the surrounding skin. Their distinguishing character is that they do not disappear or fade under pressure, in this respect differing from all forms of eruption with which they could be confounded. In a few days they begin to fade and slowly disappear, becoming orange-coloured and yellowish; new spots appear as old ones die away.

Purpura has been subdivided into P. simplex and P. hæmorrhagica. The latter is only a severer form of the former, in which hæmorrhage takes place not only into the skin but from the mucous membranes of the nose, the alimentary canal, the urinary passages, and other parts. Willan described a variety, under the name of P. urticans, in which there is a reddish elevation of the skin resembling a wheal, which subsides in a few days, and leaves a livid spot on the level of the skin. It is not accompanied with tingling or itching.

In mild cases of purpura, there is little or no disturbance of the general health. In severer cases, the eruption is often preceded by febrile symptoms, lassitude, and pains in the limbs. In some cases, however, without any previous constitutional disturbance, profuse hæmorrhage may occur both into the skin and mucous membranes.

Scorbutus is quite a distinct disease from purpura, though, like it, accompanied by cutaneous hæmorrhage. The gums are not spongy in purpura, nor is there usually the yellow sallow hue which is met with in scurvy. Some of the acute specific diseases are occasionally accompanied with petechiæ, and typhus is specially called the petechial fever from the ordinary characters of its eruption. Other symptoms will enable the practitioner easily to distinguish these eruptions from purpura. Neither the pathology nor the etiology of purpura is understood. It is not dependent on a want of fibrin in the blood, nor is it caused by the want of fresh vegetables, or even by poor living.

Treatment.—Astringents, such as gallic acid and acetate of lead, are occasionally of use. The tincture of the sesquichloride of iron and mineral acids have been useful in other cases. Turpentine and creosote have been much extolled by some writers. Dr. Williams thinks that purpura is often connected with hepatic congestion and imperfect secretion of bile, and is best treated by remedies which tend to relieve this state.

T. H.

VESICULÆ.

The vesicles to which the term *sudamina* is applied resemble minute drops of perspiration; they are colourless and very transparent. There is no redness around them. Sometimes they are so small that they are more easily detected by the finger than by the eye. In two or three days the vesicles either burst or the fluid in them disappears, and there is a little furfuraceous desquamation of the cuticle at the parts where they were situated. The contents of a sudamen never become opalescent.

Sudamina appear in the course of certain acute and chronic affections, and are especially common in typhoid fever, during the third week of the disease. A single crop of sudamina never lasts more than two or three days. I think, in common with others, that these vesicles are seated at the orifices of the sweat-ducts, and that they are connected with the occurrence of perspiration. They may cover the whole anterior and lateral regions of the trunk; but more commonly they occupy those parts to which perspiration is often limited, *e.g.* the base of the neck, the sides of the thorax, the epigastrium, and the groins.

The contents of the vesicles are almost always acid. Sudamina rarely occur after the middle period of life. They are of no value as a guide for prognosis; and as to treatment, they themselves require none. A crop of sudamina indicate that the patient has perspired, and should lead to inquiries into the ventilation and the temperature of the room, the condition of the linen of the patient, &c.

Miliaria.—Miliary vesicles are acuminated with a red halo around their bases. Their contents quickly lose their transparency, and become almost or quite purulent in appearance. Miliary vesicles occur, like sudamina, in the course of other affections. They are often seen on the trunk and extremities in acute rheumatism. They differ from sudamina in being acuminated, in the opacity of their contents soon after their eruption, and in the redness of the skin around.

Like sudamina, they appear to be connected with the occurrence of perspiration. During the summer months it is very common to see the trunk of children, and even of adults, who perspire freely from exercise or other cause, and especially if they are not frequently washed, covered with a crop of minute miliary vesicles. In these cases the redness around each vesicle is sometimes much more readily seen than the vesicles themselves, and then the disease may be mistaken for roseola æstiva. Not unfrequently roseola æstiva is complicated with the eruption of a few miliary vesicles.

Frequent ablution and a gentle purge are all that is required in the treatment of the miliary vesicular eruption of children. There is an epidemic febrile disease of from eight to ten days' duration, characterised by profuse sweating and a miliary eruption. It has been called miliary fever; some cases of it are detailed in Rayer's work on skin-diseases. Some persons under the term miliary vesicles include sudamina and miliary vesicles proper.

Eczema is a very common disease, and occurs at all ages. It is characterised by the eruption of small vesicles on imperfectly defined patches of skin of some extent. The vesicles are usually pretty thickly set. Each vesicle is surrounded by more or less inflammatory redness. Sometimes the redness around the vesicles is scarcely perceptible, sometimes the whole skin between them is uniformly red, hot, and swollen; in the latter case, however, detached vesicles are always to be found at the margin of the patches, each having its areola of redness. When the vesicles burst, thin scales or scabs cover the surface of the patches. These scales or scabs are composed of epithelium, and the fixed constituents of the fluid of the vesicles. When the fluid in the vesicles contains but little animal matter, then the scales are thin, white, and opaque, and the disease may be mistaken for one of those belonging to the order squamæ.

When the fluid of the vesicles contains much animal matter, then the scabs are brownish or yellowish in hue. Still the scabs formed from the drying up of a crop of the vesicles of uncomplicated eczema are never thick. The disease may disappear with the drying up of the first crop of vesicles; but this is by no means constantly the case. Two, three, or more crops of vesicles may follow each other in quick succession; and the surface on which they are seated may be red and raw in appearance, and a clear serous fluid, strongly alkaline in reaction, ooze from it in considerable quantity. This fluid excites inflammation of the surface over which it flows. It scalds, as it is said. Instead of being raw in appearance, it may be that the surface is hot, red, and swollen; and just under the cuticle are perfectly flat irregularly-shaped collections of serosity, or of somewhat purulent-looking fluid. The appearance is as if turbid serosity or thin pus were burrowing in all directions just under the epidermis. The fluid in this, as in other forms of eczema, is alkaline. Scabs of large extent, but still thin, are formed by the drying up of this subcuticular fluid.

Where the cuticle is rather thick, and the vesicles are very small, the surface may seem to be red and rough only, with cracks here and there, from which a more or less alkaline serosity oozes in small quantity. The surface thus affected is often of considerable extent. It is a common form of eczema on the anterior aspect of the leg in persons past the middle period of life. The urine of those who suffer from it often contains a large quantity of the crystals of oxalate of lime.

Vesicles are not, according to Hebra, constantly present in eczema, and he therefore defines eczema as follows: 'A disease of usually chronic course, characterised by the formation of aggregated papules (E. papulosum) and vesicles (E. vesiculosum) or by more or less deeply red patches covered with thin scales (E. squamosum), or in other cases by a moist surface (E. rubrum); while in any of these forms there may be developed in addition, partly yellow and gummy, partly green or brown crusts (E. impetiginosum). The affection is constantly accompanied by violent itching which leads to excoriations, and it is not contagious.' 'I do not consider the formation of vesicles, and subsequently of a moist surface, as sufficient to characterise the disease; but take in as varieties of the same malady all the morbid changes seen in the course of development and retrogression of the ordinary vesicular and moist eczema.'

The eczema papulosum is, Hebra states, the Lichen eczematoides, and eczema squamosum the pityriasis rubra of some writers.*

Varieties of eczema.—As to the nominal varieties of eczema, the disease is called eczema vulgare or simplex, when the vesicles are distinct from each other, though pretty closely crowded, last a few days only, and then dry up and form furfuraceous scales. The inflammation of the cutis in E. simplex is never very severe, and may be trifling. E. simplex may be excited by any direct irritant of the skin; as, for example, a stimulating liniment, exposure to the direct rays of the sun or of a strong fire, sugar, sulphur.

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* *Sydenham Society's Trans.* Hebra on Diseases of the skin, vol. ii. pp. 85, 86.

Eczema rubrum is distinguished from E. simplex by the degree of inflammation that accompanies the eruption; the cutis between the vesicles is uniformly inflamed; eczema simplex may therefore pass into eczema rubrum. In eczema rubrum the cutaneous and subcutaneous tissues are often considerably swollen: the swelling is, for the most part, due to the effusion of serosity.

There are two diseased states of the skin called by the common name of eczema impetiginodes. In one, the inflammation is very severe, and the secretion is here and there purulent; in the other, eczema is complicated with impetigo, *i.e.* with suppurative inflammation of the hair-follicles.

Hebra has described a variety of eczema which he terms eczema marginatum. It is almost limited to males, and especially observed in shoemakers. Its most constant point of origin is on the inner part of the thigh, with which the scrotum comes most in contact, and thence it may spread upwards to the abdomen, leaving untouched the penis and scrotum. Subsequently the disease may appear on other parts, *e.g.* breast, back, neck, extremities.

This variety of eczema begins, Hebra states, as a red, raised circular patch of the size of a sixpence; it spreads at the periphery and there occur in succession papules, vesicles, excoriations, and afterwards small brown or black scales. As the circumference spreads, the centre heals, but retains a dark colour. Subsequently similar patches may appear in other regions. Although Hebra denies the syphilitic nature of this form of eczema, other writers are disposed to question his conclusion.

The face, the hairy scalp, and the skin behind the ears are all common seats of eczema; but there is no part of the trunk or extremities which it may not, nay does not, frequently affect.

Before and during the period of the first dentition, eczema is by far the most common of the diseases of the scalp. If a single crop of vesicles only appear, the disease will run its course in a week or ten days; but if crop after crop of vesicles follow each other, or if the surface is highly inflamed and 'weeps,' the disease may continue for a considerable length of time. When very obstinate, lasting for years, it has been called eczema inveteratum. Strumous children, from five to twelve years of age, are very liable to eczema of an obstinate character at the flexures of the elbow and knee joints. An acute attack of eczema is sometimes preceded for a day or two by tolerably severe febrile disturbance. There is nothing characteristic, however, in the febrile symptoms; but the patient who has had one attack being very liable to others, he may suspect its nature. Sometimes, too, he feels before the eruption appears a peculiar heat and tingling of the part about to be the seat of the eruption.

Parts affected with eczema burn, tingle and itch. Some varieties of eczema are attended with most intolerable itching; thus in eczema of the anus, of the labia pudendi, and of the scrotum, especially in old men, whose urine dribbling away irritates that part, the itching is often intolerable. Eczema is not contagious.

In children, as a rule, eczema is secondary to some constitutional state. In adult age it is more commonly due to direct irritation, as about the vulva in saccharine diabetes. In females it now and then appears in connection with derangement of the catamenial function, without known local exciting cause. Eczema of the lower extremities is sometimes secondary to a varicose condition of the veins.

Treatment.—The treatment of an acute attack of eczema must be influenced by the severity of the local affection, the presence of febrile disturbance, and the age and strength of the patient.

If the disease be acute, the local affection extensive, and accompanied by a good deal of heat, redness, and swelling, and the patient in the prime of life and robust, the best treatment is to take a moderate quantity of blood from the arm, to give a brisk calomel-and-colocynth purge, to follow this by a saline antacid aperient, and to bathe the part itself with tepid goulard water. After the bowels have been freely acted on, small doses of antimony may be given every three or four hours. The diet in such cases should be low. If the patient be less robust, then the bloodletting must be omitted, and the purging and other treatment be less active.

If the disease be chronic, and the inflammation moderate in degree, a bitter acid aperient, such as sulphate of magnesia one drachm, dilute sulphuric acid 10 drops, infusion of gentian $1\frac{1}{2}$ ounce, two or three times a day, is often very useful. Young children require occasionally a calomel-and-jalap aperient at bedtime. In the chronic forms care must be taken to ascertain that the patient is committing no error in diet. It is only in the aged or the delicate that stimulants, as wine or beer, are admissible. Slightly astringent local applications, as zinc ointment, are the best for mild cases. If the disease is very chronic, and there is little heat of the part, stronger local means are required, such as an ointment composed of half a drachm of the hypochloride of sulphur to 1 ounce of simple cerate, or a scruple of iodide of sulphur to half an ounce of simple cerate. In the strumous variety above mentioned as so common at the bends of the elbows and knees, and in that in which the cuticle is rough and cracked, and there is serous fluid oozing from the surface, a piece of linen soaked in a solution of nitrate of silver, a scruple to an ounce of water, may be applied twice a day. When, in the last-mentioned form, the urine contains a very large quantity of oxalate-of-lime crystals, the nitro-muriatic acid, with decoction of bark and a good diet, should be prescribed. In strumous children, cod-liver oil and a good diet are essential to the cure. When young children suffer from eczema of the scalp, and the gums are hot, dry, and swollen, they must be lanced. If the disease continue, and the inflammation does not involve the cellular tissue, I have seen the disease rapidly yield to the plan of treatment recommended by Hebra. The hair being cut off by a fine pair of scissors, and the scabs removed by linseed-meal or bread-and-water poultices, linseed-oil is to be applied at bedtime to the whole scalp, and the following morning the part is to be covered with liquid pitch; a single application is sometimes sufficient for the cure; when the pitch peels off, the scalp is found free from eruption or inflammation. Care must be taken not to employ so stimulating an application as liquid pitch when there is much heat and swelling of the part, for a child in the Hospital for Sick Children was nearly killed under such circumstances by the inflammation set up by the pitch. The inflammation extended from the scalp down the neck, and even below the clavicles. Abscesses of some size formed in the cellular tissue of the inflamed parts. However, when the child recovered from the terrible disease excited by the pitch, it was free from the eczema. It had been suffering from the affection of the scalp for two years; sometimes it was almost well, and then again, without apparent cause, an acute attack supervened, and the child was as bad as ever; the cure effected by the pitch was permanent. In very obstinate cases, in children as well as adults, arsenic administered internally exerts a decidedly favourable influence; three or four minims of the liquor potassæ arsenitis in a little water twice a day to an adult, and a single minim to a child.

Parts affected with eczema should be washed frequently. Strong soaps should not be employed. Some physicians recommend the patient to use a little bran-water only; others employ egg instead of soap for washing the part. It is desirable to prevent the secretion from the inflamed surface running over the adjacent healthy skin; therefore the part should very frequently be wiped gently with a piece of soft lint. Dr. H. Bennet speaks in very high terms of the advantage he has seen follow from keeping the part constantly wet with a solution of subcarbonate of soda, two drachms to a pint and half of water. To prevent the lint drying, it is necessary to cover it with oil-silk or gutta-percha. The constant application of cold water is strongly recommended by Hebra; over the water a caoutchouc bag containing ice may be applied. He also after removing crusts employs various caustic applications, especially caustic potash, in form of solution or of soap.

The treatment of eczema may be thus summed up. If the local affection be manifestly inflammatory, it must first be treated altogether independently of the special eruption. When the active inflammatory stage has passed by, stimulating astringents must be applied locally, and the constitutional derangements treated as though there was no local affection; and lastly, these means failing, those remedies must be employed which may be denominated empirical. Always bearing in mind the importance of a diet regulated according to the age and general powers of the patient, and the necessity for local cleanliness.

Herpes is, like eczema, a non-contagious vesicular disease very common at all ages. It differs from eczema, however, in several particulars. The vesicles are arranged in groups on small, or at least not very large, pretty well-defined and somewhat elevated red patches. The vesicles of eczema are always small; those of herpes usually of some size.

The fluid of the vesicles is at first quite transparent, but it soon grows opalescent or puriform, and after a short time the fluid and the epidermic covering of the vesicles concrete into a thin pale brownish scab. When quite transparent, the fluid of the vesicles is slightly alkaline or neutral to test-paper; when opalescent, neutral or acid. The fluid of the vesicles in herpes never has the strongly alkaline reaction so remarkable in the transparent fluid that 'weeps' from the red surface of a patch of eczema.

Varieties of herpes.—The red slightly elevated patch that so often forms on the lip during that little feverish attack commonly called a cold, and which is shortly after covered by a crop of vesicles, is H. labialis. In a day or two the vesicles are replaced by a thin brownish scab: in two or three days more the scab falls off and a red stain only remains. When such an eruption occurs on the prepuce, as it often does, it is herpes præputialis. Patches identical with these, except that they are broader, and that the vesicles on them are larger, may appear on any part of the body, constituting herpes phlyctænodes. The cheek is a common seat of herpes phlyctænodes. Several patches often appear in the vicinity of each other. The disease ceases, as a rule, in less than a fortnight. Sometimes a week suffices for it to run its course.

Herpes zoster, zona, or *shingles,* as it is vulgarly called, is distinguished from the other varieties of herpes by the number and position of the patches of vesicles. Several patches, distinctly separated from each other, appear at the same time or in succession. These patches are usually oval, and arranged on a line passing somewhat obliquely downwards and forwards from the spine to the middle line, in front. Most commonly they are seated on the thorax, next on the abdomen, and rarely on the face and neck. The patient is usually poorly for two or three days before the vesicular patches show themselves; sometimes considerable febrile disturbance precedes the eruption, and occasionally the patient suffers severe burning pain in the part where the eruption is about to appear, and even deep-seated pain in the chest when the thoracic parietes are to be its seat. H. zoster rarely occurs on the two sides of the body, and still more rarely is it symmetrical.

At first the contents of the vesicles are transparent, then turbid, and then thin brownish scabs follow. The disease runs its course in ten days or a fortnight. In rare cases, and only in adults, after the scabs fall off, the part on which they were seated is the seat of very severe and long-continued neuralgic pain.

Herpes zoster affects young children more frequently than it does adults. No age, however, is exempt. Herpes zoster rarely occurs twice in the same individual. In children and young adults it is a disease, medically speaking, of little moment.

As to the pathology of herpes zoster the eruption is secondary to a general febrile affection, and the seat of the eruption is determined by the distribution of particular nerves, and most commonly of the dorsal nerves. The pain that precedes the redness, the limitation of the disease to one-half the body, the frequency with which it follows the course of some of the dorsal nerves on the thorax and abdomen, and even the fact that in some cases the upper arm has formed, so to say, part of the semicircle,—all point to this conclusion. In reference to these last facts it may be observed that the lower intercostal nerves supply cutaneous branches to the abdominal integument, and that the second dorsal nerve supplies a branch to the skin of the upper arm, viz., the intercosto-humeral. When on the face it follows the distribution of the fifth nerve, usually one division only; I have seen many cases of two divisions affected. Mr. Hutchinson has observed iritis complicate herpes following the course of the ophthalmic division of the fifth nerve. Theoretical consideration led Von Barensprung to regard the primary lesion to be irritation of the ganglia on the posterior roots of the nerves; the disturbance of the contiguous sensory fibres producing the neuralgia. Subsequent anatomical examinations have to some degree confirmed this view of the exact pathology of the Herpes zoster.

Treatment.—A mild aperient and a simple saline only are needed. No local treatment is required; nay, local applications very often seem to do harm; troublesome ulcers often follow the application of the most simple dressings. Herpes zoster is an acute disease, having a definite course and duration; a disease that, if let alone, is sure to get well, supposing the patient not to be very old or infirm. But the vulgar have an idea that, if the disease pass round the body, death from it is certain; and in some parts of the country the poor regard it as a most serious disease. Gangrene of the parts affected in very rare cases follows in infirm aged persons.

The neuralgia which now and then occurs as a sequel to the eruption is best treated by local anæsthetics, as belladonna, or chloroform. Not unfrequently it resists all treatment.

Herpes iris is a very rare variety. Each patch is about the size of a sixpence, and constituted by three or four concentric rings of different shades of red. On these rings the vesicles are situated; a solitary vesicle occupies the centre. Willan states that the back of the hand is the most common seat of herpes iris; that it is not connected with any perceptible constitutional disorder; that it disappears spontaneously; and that it is limited to young persons.

Herpes circinnatus occurs at all ages. The breadth of the red ring in herpes circinnatus varies from a line to a third of an inch; the diameter of the ring, from a quarter to two inches; the size of the vesicles, from the smallest perceptible by the eye to almost as large as the half of a small split-pea.

When the vesicles are of large size, they undergo the same changes which vesicles of herpes zoster experience; that is to say, at first the fluid in the vesicles is transparent, then turbid, and then the walls of the vesicles and their contents dry up into brownish scabs. A second crop of vesicles may follow; but the disease usually runs its course in a week or ten days. Sometimes several patches of the same kind appear in succession on various parts, and thus the disease may be prolonged for some little time.

As to the treatment of herpes circinnatus with large vesicles, a gentle aperient, rest, and a light diet only are required.

That variety of herpes circinnatus in which the vesicles are very small is by far the most common and the most important. It is *the ringworm* of the face, trunk, and extremities. From the frequency with which minute scales are found on the red ring, it may be called the furfuraceous variety of herpes circinnatus, and to this variety only the following remarks apply.

Herpes circinnatus commences as a red spot; and the annular shape is the result of the extension of the inflammation at the margin of the spot while the centre regains its healthy aspect. It is one of the centrifugal affections of the skin. Occasionally a second, a third, and even a fourth ring is seen within or without the primary circle. Every now and then we meet with cases in which the centre of the ring, instead of regaining its healthy structure as the margin extends, is the seat of repeated eruptions of very minute vesicles, and so has a rough, rather scaly, appearance. This latter form is especially common in strumous children, whose skin is naturally rough. It is peculiarly chronic in its course.

The furfuraceous variety of herpes circinnatus is a purely local affection. In this it differs from most of the other species of herpes. In herpes zoster, phlyctænodes, and labialis, the eruption is preceded by, and is altogether secondary to, a general febrile state. The local affection in these diseases bears the same sort of relation to the general state that the rash of measles bears to the general state that precedes its eruption. Herpes circinnatus is not secondary to, or even accompanied by, any constitutional derangement. It differs in another particular from most of the varieties previously described. They are acute diseases; it may be a chronic affection. Each crop of vesicles runs, it is true, an acute course; but repeated crops often give to the disease a chronic character. The furfuraceous variety of herpes circinnatus may by the inexperienced student be confounded with roseola annulata, erythema circinnatum, psoriasis vulgaris, lichen circumscriptus, and tinea tonsurans. In psoriasis the elevation of the red ring is greater than in herpes circinnatus, and the scales form the prominent feature of the local disease, instead of requiring to be looked for, as in herpes circinnatus. There are no elevation of the skin, no vesicles, and no scales in roseola annulata. The abrupt outer margin, the breadth of the ring, the yellowish tint of the centre, and the absence of vesicles and scales, distinguish erythema circinnatum. Lichen is a papular disease.

Treatment.—Topical applications only are required for the cure of the furfuraceous variety of herpes circinnatus. Local astringents and stimulants are the remedies. The vulgar apply ink, and cure many cases by it. A concentrated solution of sulphate of iron answers well in some cases; so also does a saturated solution of gallic acid. A single application of strong acetic acid, or of a strong solution of nitrate of silver (a drachm to the ounce of distilled water), or of blister-fluid, will occasionally suffice to remove a patch of herpes circinnatus which has resisted less powerful agents. This furfuraceous variety of herpes circinnatus is contagious. It is almost limited to the young, and is far more common in childhood than in early adult age. In and by itself herpes circinnatus is a trifling affection; but considered in reference to the relation it bears to the development of the vegetable parasites, it is a very important disease.

PARASITÆ.

Tinea is the generic name of all the diseases of the skin characterised by the presence of vegetable growths in the substance of the hair.

Tinea tonsurans is a very common disease of the hairy scalp, seen only in children, and by far the most frequently between the ages of two and twelve years. It is called *Porrigo scutulata* by Willan, *Herpes tondens* by Cazenave and G. Simon, and *Trichinosis furfuracea* by E. Wilson.

Tinea tonsurans occurs in more or less circular patches varying in size from a sixpence to a crown-piece. All the hairs on the patches appear to have been evenly cut off at about an eighth of an inch from the surface of the scalp. These short hairs are much thicker and more opaque than are the hairs on the other parts of the head, and as the diseased hairs have lost their elasticity they are here and there twisted or bent at an angle on themselves. The surface of this patch is generally covered with numerous loosely attached opaque white scales, and imbedded in these are many opaque, thick, twisted short hairs. When the scaliness of the patch is trifling, the orifice of each hair-follicle may be observed to be surrounded by an opaque white fringe, formed of accumulated epithelium, and the hair-follicles themselves are too prominent.

The patches on which the hairs, &c., are thus diseased are very slightly raised, and are a little redder and hotter than the other parts of the scalp.

Microscopic examination.—The thickness, opacity, brittleness, and loss of elasticity of the hairs are seen, by the aid of a magnifying power of two hundred diameters, to be due to the presence in the substance of the hair of a vegetable parasite. The scales are formed of epithelium, studded with the sporules and mycelium of the same parasite. The plant is the trichophyton tonsurans; the sporules of the plant are found between the inner root-sheath of the hair-follicle and the hair; from this spot the parasite enters the hair; and the mycelium, bearing innumerable sporules, passes between the anatomical elements of the hair, separating them from each other in the most remarkable manner. Passing up from the interior of the hair-follicle to its orifice, the mycelium and sporules spread in all directions among the epithelial scales.

Pathology.—Some writers maintain that tinea tonsurans and herpes circinnatus are the same disease. The closeness of the relation between the two is shown by the fact that a patch of herpes circinnatus seated on the forehead or back of the neck, as not infrequently happens, and extending in size till the upper part of the ring involves the hairy scalp, may retain on the hairless part the characters of herpes circinnatus, while that portion of the ring which occupies the hairy scalp has all the characters of tinea tonsurans; and also by the fact, that in the scales, which can be scraped from the surface of the red ring of herpes circinnatus of the trunk, are occasionally to be found some of the mycelium and sporules of the little fungus.

But, on the one hand, a patch of herpes circinnatus is often seen on the trunk, and occasionally on the scalp, without a trace of the trichophyton to be detected among the débris of its vesicles; and, on the other hand, a patch of tinea tonsurans is occasionally seen on the scalp, on and around which no trace of herpes circinnatus can be found.

From these facts it follows,

1st. That herpes circinnatus and tinea tonsurans are distinct diseases.

2nd. That tinea tonsurans owes its peculiar characters to the presence of a parasitic vegetable growth.

3rd. That the secretions of the part of the skin affected with herpes circinnatus form a favourable nidus for the growth of the parasite.

In tinea tonsurans there is first some disorder in the secretions of the hair follicles,—a disorder, it may be, attended with no changes perceptible to the eye. If sporules of the trichophyton tonsurans fall on the soil so prepared, they take root; the plant grows downwards between the hair and its root-sheath—outwards, upon and among the epithelium of the scalp upwards into the hair, penetrating it, and passing into its shaft. To the existence of the parasite all the visible phenomena are due. Its presence in the substance of the hair causes its increased thickness, opacity, loss of elasticity, and brittleness. Its presence in and among the epithelium leads to the desquamation of the latter, and, as a consequence, to the abundance of the scales; its presence in the hair-follicles to the swelling of the follicles and to the little fringe around their orifice, and also to the determination of blood to the part. The elevation of the part and its increased temperature are consequent on the flow of blood to it. Tinea tonsurans is undoubtedly contagious.

Treatment.—The great object to be attained in the treatment of tinea tonsurans, whether the disease be primary or engrafted on herpes circinnatus, is the destruction of the plant; for so long as the fungus is present, so long will there be increased flow of blood to the part, secretion of a substance favourable to the growth of the plant, and, as a necessary consequence, persistence of the conditions of hair and scalp resulting from the presence of the plant.

How can we destroy or remove the plant? We are acquainted with various agents destructive to vegetable life. The application of any one of these to the diseased patch would no doubt quickly effect our object, were it not for the difficulty of making the parasiticide penetrate into the substance of the hair as low as its root, and pass down to the base of the hair-follicle.

Such preparations are the following: bichloride of mercury four grains, lard two drachms; acetate of copper half a drachm, lard four drachms; ammonio-chloride of mercury twenty grains, sulphur ointment four drachms; strong blistering fluid; creosote twenty drops, lard two drachms; carbolic acid 1 part to 300; strong sulphuric acid, washing the part directly after with cold water; and a saturated solution of sulphurous acid. Although any and all of these means will sometimes effect a cure, I am disposed to prefer as most uniformly successful the sulphur and white precipitate ointment. Dr. Gull, I am told, has found the strong sulphuric acid rapidly cure the disease. Dr. Coster of Hanwell schools employs a solution of two drachms of iodine in one ounce of oil of tar: this solution is to be painted on the part with a firm brush.

Whatever treatment may be adopted, cleanliness is essential. The patches should be well washed from time to time, so as to remove the scales, and with them innumerable sporules and much mycelium. As a detergent a solution of borax will be found useful. The parasiticide ointment should be well rubbed into the part at least twice a day.

It has been proposed to pull out the hairs from the patch; and no doubt the success of the epilation would be marked, if it were possible to perform it. But epilation is impracticable; the hair breaks off just above the point where it emerges from its follicle. In rare instances only can the root of the hair be extracted, and in rarer instances still can the root-sheath be got out with the hair. Blistering the part assists in the removal of the hairs. As the secretion of the hair-follicles in strumous children seems particularly favourable to the growth of the tricophyton tonsurans, cod-liver oil is useful.

It is satisfactory to know that although tinea tonsurans may be very obstinate, it always disappears after a time, and, further, that it never causes even partial baldness.

Tinea favosa or favus, though common in Holland and some other parts of the Continent, is a rather rare disease in England. Its ordinary seat is the hairy scalp. Now and then, however, it occupies other parts.

Be it situated on scalp, trunk, or extremities, the disease is primarily seated in the hair-follicles, and is characterised by dry brimstone-yellow crusts, each crust being cup-shaped, and having a hair running through its centre. The size of the crusts varies from a mere point to half an inch in diameter. The separate crusts coalesce as they increase in size and number, and thus a large, dry, irregularly-pitted crust is formed. The crusts are buried to some depth in the cutis, so that if one be raised from its place, a depression of the cutis is exposed in which it was imbedded. The depressed surface is always redder than healthy skin; but only here and there is the cutis denuded of its epithelial covering. Among the dry crusts are usually a few pustules. These pustules are an accidental complication indicating the coexistence of impetigo.

The crusts of tinea favosa have a peculiar fœtid odour, and from the impediment they offer to cleansing the head favour the occurrence of vermin. The pediculi are found chiefly in the fissures of the large crusts. Intolerable itching is often experienced. There is a variety of tinea favosa in which the crusts are from the first amorphous, wanting in the cup-shaped character, and less bright in colour.

Microscopic examination.—The pus from the pustules contains the corpuscles characteristic of that fluid. The dry yellow crusts are composed of the mycelium and sporules of the achorion Schönleinii. The sporules of the achorion Schönleinii are oval, and much larger than those of the trichophyton. The mycelium and the sporules can both be seen readily in the hair which runs through the centre of each dry sulphur-coloured crust.

The steps of the disease are these: first, there is thickening of the root-sheath of the hair-follicle, and accumulation of its secretion about its orifice. So long as there is nothing more than this, we are not able to say that any disease exists; but let the sporules of the achorion fall on the prepared soil, and the sulphur-coloured crusts of tinea favosa are rapidly formed. The plant grows outwards between the layers of epithelium, downwards into the follicle, and entering the hair near to its root, shoots upwards into its substance.

The trycophyton tonsurans, the plant proper to tinea tonsurans, grows into the hair-follicle; but its presence inflicts no permanent injury on the structures of the follicle. The achorion Schönleinii, unless it be soon eradicated, destroys the follicle, and permanent baldness is the consequence.

Herpes circinnatus bears the same relation to tinea favosa that it does to tinea tonsurans. The secretion of herpes circinnatus is as favourable to the growth of the achorion as it is to the growth of the trichophyton. Tinea favosa is, like all the diseases of its class, contagious; but the achorion requires a favourable soil for its growth. The disease rarely spreads in the hospital.

The writer had a case of tinea favosa for some time under his care in the Hospital for Sick Children: not a child caught it till a case of herpes circinnatus was admitted into the same ward. On several children rings of herpes circinnatus soon after appeared; and two of the [children thus affected now caught tinea favosa, and the crusts of the tinea favosa occupied the centre of the patches of herpes circinnatus.

As these cases are of interest from their bearing on the pathology of the affection, one may be quoted at length.

On the outer aspect of the right arm, just below the elbow, is a pinkish-red patch, slightly elevated, nearly circular, and five-eighths of an inch in diameter. The centre of this patch is occupied by ten or twelve crusts of tinea favosa, the largest not more than a line in diameter, the smallest requiring a lens for its detection. The largest are distinctly depressed in the centre, the smallest are merely yellow spots. Through the centre of each crust runs a little hair. A few white scaly-looking points are scattered around the part occupied by the crusts. The circumference of the patch is covered by pretty closely set, flattened vesicles; the majority so small that they might escape observation, unless the part were examined with a lens.

On the right shoulder, the left upper arm, and the left leg, are patches of similar character.

Passing from the circumference to the centre of the patch are—

1st. A ring of the vesicle of herpes circinnatus.

2nd. Scales formed by the drying of the vesicles.

3rd. Crusts of tinea favosa.

Some of the crusts are mere points, the disease being limited to the very orifice of the hair-follicles. There are no pustules; not a trace of suppuration; a sufficient proof that the disease is not pustular at its commencement.

As without the existence of the plant trichophyton there could be no such disease as tinea tonsurans, so in regard to tinea favosa, were there no such plant as the achorion Schönleinii, there could be no such disease as tinea favosa. The soil requires preparation; but all the visible phenomena of the disease—those appearances which we call tinea favosa—are the direct consequences of the presence of the plant.

Treatment.—The objects to be kept in view in the treatment are to remove or destroy the plant, and to improve the state of the secretions of the part which is its seat. As the subjects of tinea favosa are often strumous, benefit is obtained under such circumstances from the administration of cod-liver oil, syrup of iodide of iron, calumba, rhubarb and soda, and other remedies of the same class. But all other means will fail unless the plant be destroyed and removed. For this purpose, parasiticide substances—that is to say, substances destructive of vegetable life—are to be applied, and at the same time so much of the plant as possible removed by mechanical means.

The crusts are to be removed by a bread-and-water poultice, or, better still, by the continuous application of lint dipped in a solution of sulphurous acid. Bichloride of mercury, dissolved in water or mixed with lard in the proportion of eight grains to the ounce, and acetate of copper mixed with lard, half a drachm to the ounce, are two of the most powerful parasiticides. A saturated solution of sulphurous acid properly applied is an excellent remedy; a piece of lint dipped in the solution is to be closely and constantly applied to the affected part, and this covered to prevent evaporation by oil-silk, or by a second piece of lint spread pretty thickly with lard. If the disease be on the trunk or extremities, and the general health good, it may be rapidly cured in this manner. The girl whose case is above described was permanently cured in a few days. But if the disease be seated on the hairy scalp, and the plant has entered the hair-follicles, and shot up into the hairs themselves, considerable difficulty is experienced in bringing the parasiticides in contact with the plant, and as a consequence epilation is almost essential for permanent cure. If the hairs be pulled out before the hair-follicle is destroyed, no baldness follows.

Epilation may appear to be a very painful operation, but if well performed it is not so. Each hair should be grasped with a pair of forceps adapted to the purpose just where it escapes from its follicle, and pulled sharply in the line of the direction of its insertion into the follicle. As the hairs are much less firmly fixed in their follicles than in health, epilation is so much the more easily effected. If the disease be limited in extent, no practical difficulty exists to its cure by epilation; if it occupies the whole or a great part of the scalp, the cure requires much time and great patience. So long as a sporule or a branch of mycelium remains in a hair undestroyed, so long is it certain that the disease will return.

Before epilation, l'huile de cade is by many applied to the part from which the hairs are to be removed. It is said to diminish the sensibility, and loosen the attachment of the hair to its follicle. The old pitch-cap was merely a quick mode of epilation, and not so painful as might be supposed. If herpes circinnatus be present, the extension of the ring of vesicles should be prevented, and on their first appearance the small patches of herpes should be destroyed with nitrate of silver.

Tinea favosa is the disease described by Bateman under the name of porrigo lupinosa. The porrigo favosa of Willan, Bateman, and Thompson is a species of impetigo. These excellent observers mistook the yellow crusts of tinea favosa for dried pustules.

Tinea decalvans is very readily recognised. The roots of the hairs atrophy, till at length, being smaller than their follicles, they fall out. Commencing at a point on the hairy scalp, the disease spreads circularly till a bald patch of some size is formed. Now and then, the bald patches are irregular in form; still even then the margin of the patch is usually scolloped, as though the large patch had been formed by the coalescence of several smaller patches. The disease may ultimately involve the whole scalp; nay, occasionally, the hairs of the eyebrows and the eyelashes are similarly affected, and fall in like manner from their follicles. There is neither redness, heat, tenderness, nor any eruption on the bald patches; usually, indeed, the bald scalp is something paler than natural.

Tinea decalvans is common enough in children and young persons. It more rarely affects those of more advanced age. The patches from which the hair has fallen are quite smooth. The patches of tinea tonsurans must not be confounded with those of tinea decalvans. In the latter the surface of the patch is quite smooth—there is local baldness, and that is all; in the former the hairs look as if they had been cut off just above the point at which they emerge from their follicles.

This disease is called tinea in deference to the statements of Bazin and others; the writer has never detected any vegetable growth on or in the hairs about to fall from their follicles. The plant, the microsporon Audouini, is said to be found attached to the hairs just above the surface of the scalp. The atrophy of the bulb of the hair is considered to be secondary to the action of the plant. Willan called this disease porrigo decalvans. It is called by some alopecia circumscripta.

Treatment.—If the patient be pale or weakly, iron and cod-liver oil may be given. Local stimulation is, however, far more important. Tincture of iodine is a convenient stimulant; it may be applied night and morning. A saturated solution of sulphurous acid is very efficacious. It should be applied constantly by means of a piece of linen soaked in the solution, and covered with an oil-skin cap. The linen requires to be wetted many times a day. Sometimes the saturated solution of the acid is too stimulating; and if so, it may be diluted with as much or more water—just so much diluted as that it may produce a little redness of the scalp, but no eruption. If the patches be small, tincture of iodine is the best application; when the disease is extensive and spreading rapidly, the head should be shaved, and the sulphurous-acid lotion applied. If less powerful stimulants fail, blisters may be applied. As the hair-follicles are seriously at fault, and new hair has to be formed, a cure cannot be quickly effected. The first sign of improvement is the presence of a little downy hair on the patch. This down is, after a time, replaced by better-formed hair, and this again by still more perfect hair. The baldness is never permanent.

Tinea sycosis, or *mentagra*, as it is often called, is a disease of the beard, moustache, whiskers, and inner surface of the nares, in which a little fungus finds a nidus between the root of the hair and the wall of its follicle. The plant is the microsporon mentagrophytes, and it makes its presence known by the inflammation it excites. The inflammation causes thickening and induration of the tissues around the follicle, and suppuration of the follicle itself. As the disease originates in the follicle, a hair may be seen to traverse the centre of each pustule. The pus and epithelium about the orifice of the follicle dry into a thick brownish scab. When the scabs are numerous, and the parts about tuberculated from the swollen and irregular induration around the follicles, the part affected with pus being supposed to have some resemblance to the pulp of the fig, the name sycosis has been given to it. Between the scabs are often seen little scaly particles formed of epithelium. Sycosis may be confounded with impetigo; but the induration and swelling of the tissues is trifling in impetigo. Acne of these parts also may be taken for sycosis; but in acne the induration is greater than in sycosis, and the suppuration less rapid. There is no vegetable parasite in the hair-follicles in impetigo, nor in the sebaceous follicles in acne.

Tinea sycosis is often a very obstinate affection.

The *treatment* of this disease is to be conducted on the same principles as those of the other affections of its class. Substances destructive to vegetable life are to be applied to the diseased skin; and as the plant is *in* the hair-follicles, they must be applied in a form fitted to enter the follicles. An ointment of lard and corrosive sublimate, in the proportion of a grain to the drachm, is sometimes very useful. The white precipitate ointment of the London Pharmacopœia may effect a cure. Dr. Thompson recommends strongly an ointment composed of a scruple of iodide of sulphur and an ounce of lard. Warm fomentations and poultices, by removing the scabs and allaying the inflammation, afford much relief to the patient. The condition of the digestive organs must be attended to, and purgatives, tonics, and antacids exhibited as required. A good and generous diet is usually necessary. Epilation is sometimes essential for effecting a cure.

Chloasma or *pityriasis versicolor*, is a very common disease. Its most frequent seat is those parts of the neck, upper arms, chest, and abdomen, which are covered by the flannel jacket. The axillæ, however, usually escape. It is curious to note how often the disease is limited exactly to the parts in contact with the flannel. In such cases its occurrence is favoured by want of cleanliness.

Many people are so dirty in habit as to wear the same flannel next their skin for a week, a fortnight, three weeks, and, among the poor, even a month. And it is by no means an uncommon thing for them to wear the same flannel night and day, not once removing it from the moment it is put on till the time it is considered to be desirable to have it washed. The consequence of such habit is an accumulation on the surface of the skin of its secretion and of undetached epithelium, and the consequent formation of a nidus favourable to the growth of the microsporon furfurans. This plant finding, then, in the epithelial accumulation saturated with the secretions a fitting soil, spreads under its outer layer in all directions, and by its presence produces the pale yellowish-brown patches characteristic of Cloasma. At the margin of the larger patches are numerous detached brownish-coloured circular spots. The spots are scarcely raised above the surface of the skin. Like all the other vegetable parasites, the microsporon furfurans exhibits a disposition to spread from the point on which it alights uniformly in all directions. Hence the circular form of the patches. The large irregularly-shaped patches are formed primarily by the coalescence of the smaller. If one of the brownish patches be rubbed, a number of minute scales will be detached, and the cutis underneath will be seen to be somewhat redder than the adjacent skin. The only annoyance the patient experiences is itching of the part on exercise or when heated, and the consciousness of having very unpleasant-looking skin beneath his jacket.

Microscopic examination.—If one of the delicate scales from a patch of chloasma be placed in a little alkaline fluid, and examined with a magnifying power of 250 diameters, it is seen to be formed of epithelial scales studded with the mycelium and sporules of the microsporon furfurans. If to the scale water only be added, the plant will not be visible. The alkali renders the animal matters transparent, and leaves the plant unchanged. The microsporon is seated on the under surface of the epithelial scales, no part of the plant projecting beyond the margin of the scale on which it grows.

Treatment.—To cure the patient, his dirty habits must be reformed, supposing him to be of such. He must change his flannel frequently, and never sleep in that which he wears during the day. He must wash daily, not merely his hands, but his whole trunk and extremities, using hot water and strong soap. After washing, he must rub the surface well with a flesh-brush, taking care that the latter is itself often cleansed. In addition to these frequent and careful ablutions and frictions, by which a large quantity of the fungus is removed, the patient should bathe the part affected with a parasiticide lotion, composed of twelve grains of bichloride of mercury to four ounces of water. The lotion should be allowed to dry on the part. A saturated solution of sulphurous acid may be applied freely with the same object, viz. to kill the fungus. A lotion of sulphuret of potassium, one drachm to the pint of water, will cure: but then it is offensive. Some consider a course of arsenic essential to the permanent cure; but it is not so.

No doubt some persons who are very cleanly in their habits and some who are as cleanly as their clear-skinned neighbours, suffer from chloasma. One concludes, therefore, that in some instances the secretions of the skin are abnormally favourable to the growth of the fungus. In some of these cases arsenic may be of service; so too is cod-liver oil.

Phthisical people often have patches of chloasma on their chest or elsewhere. This is the result, partly at least, of want of cleanliness. Persons delicate in the chest, as they call it, are frequently afraid of washing more than face and hands. Again, they usually keep themselves closely wrapped in flannel, and are somewhat too fearful of changing it; and, yet further, sweating, alternating with heat of skin, is common in such cases—conditions favourable to the formation of a good nidus for the microsporon furfurans.

Like all the parasitic diseases, chloasma is contagious.

A certain number of facts have been recorded, tending it is thought by some dermatogists to establish the identity of the several human vegetable parasites, *i.e.* to show that trychophyton tonsurans, achorion Schönleinii, &c., are stages of development of the same fungus. Dr. Tilbury Fox in this country has with much ability advocated this opinion and even concluded from his observations that penicillium glaucum and the favus fungus are identical. Still, up to the present time, the weight of evidence is decidedly on the side of the non-identity of the fungi in question.

The following appears to me to be the present state of knowledge on the subject and on the relation between herpes circinnatus and parasitic diseases.

1. That Herpes circinnatus may occur without any vegetable parasite being able to be detected on the part.

2. That trychophyton tonsurans is frequently present in the scales of H. circinnatus and in the hairs of the part.

3. That if a wet bandage be applied over the skin of a part on which trychophyton tonsurans has been scattered, patches identical with those of Herpes circinnatus containing the parasite are produced.

4. That microsporon furfurans can be inoculated in the same manner, but then no other disease than Chloasma follows.

5. That if achorion Schönleinii be inoculated, tinea favosa is produced, but that an herpetic stage resembling H. circinnatus precedes the favus stage, and that in some cases the disease aborts at the herpetic stage, no favus crusts being formed.

6. That patches of true Herpes circinnatus are more liable than other parts of the same person to be inoculated with achorion Schönleinii and so to have favus crusts form in their centre.

7. That the lower animals, the cat especially, suffer from tinea tonsurans and tinea favosa, and that man may be inoculated from the lower animals.

8. That the microscopic characters hitherto noted of the various parasitic fungi, while amply sufficient to enable the one plant to be distinguished from the other, are not sufficient to prove their essential non-identity, *i.e.*, to prove that they are not different stages of development of the same fungus.*

With reference to the nomenclature of these diseases, characterised by the presence of vegetable parasites, it should be remembered that—

Tinea tonsurans was called by Willan and Bateman porrigo scutulata.

Tinea favosa was called porrigo lupinosa.

Tinea decalvans was called porrigo decalvans.

Chloasma was called pityriasis versicolor; while the

Porrigo favosa of the same authors was a variety of impetigo.

Scabies.—The eruption of scabies is caused by the presence of a minute animal parasite, the *sarcoptes hominis*, in the under layer of the epithelium. The sarcoptes hominis has been taken from its burrow, placed on a healthy person, and the disease in that way communicated. It is by the passage of the parasite from one person to another that the disease spreads; hence the hands in the adult, and the buttocks and loins in children too young to walk, are the especial seats of the disease. In children the hands often escape; in adults the parts of the hands where the skin is most delicate are the parts first to suffer, *i.e.* between the fingers, the bend of the wrist, the root of the thumb, and the inner margin of the hand. Scabies never affects the hairy scalp or the face of the adult, and only rarely the face of the child.

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* Höbner u. Strabe, *Klin. u. exp. Mittheilung*, Canstatt, J. B., 1864. Starck u. Hallin, *Jena Zeitschrift*, Canstatt, J. B., 1865. Pick, *Untersuchung in der Pfl. Hautkrankheiten.* McCall Anderson 'On the identity of the parasites met with in favus, tinea tonsurans, and pityriasis versicolor.'

The eruption appears to be produced thus: The animal bores a way through the outer layer of the epidermis, and then for some distance onward, in the softer layer of the epidermis. Immediately adjacent to the point at which the animal passes into the epidermis, a vesicle, papula, or pustule is formed. The sarcoptes itself is found at the end of the faint whitish line or burrow, leading from the vesicle or papule. The burrow varies from a line to an inch in length. When the disease affects the delicate skin between the fingers or toes, and continues for some time the cuticle thickens and cracks. These cracks are very characteristic of the disease; the vesicles, papules, and pustules, and the delicate line leading from a few of these are the only disease of the skin directly resulting from the animal's presence. The blackish points, the linear abrasions, the broader inflamed patches, and the ulcers so common in the young child, are the consequences of injury inflicted on themselves by the patients, in their endeavour to allay the intolerable itching. Hebra has pointed out that when the paralytic are the subjects of itch, none of these severer effects of scabies are observed. The vesicles of scabies are scattered irregularly over the part affected; many of them seem buried somewhat in the skin, so that they may be mistaken for papules. These deep-seated vesicles are never acuminated, and there is little or no redness around them; on the apices of some of the papules a minute vesicle may be detected by the lens; those vesicles, the vesicular character of which is more evident, are acuminated, and may or may not have some redness around. The phlyzacious pustules often attain a considerable size.

The superficial acuminated vesicles are best seen between the fingers and toes and at the bend of the wrist, the disease being recent; the cracks in the same situations when the disease has lasted some time; the buried vesicles on the upper extremities, and where the epidermis is naturally rather thick—the burrows of the sarcoptes on the sides and anterior aspect of the fingers. It is a matter of some interest, as showing the accidental nature, so to say, of the eruption, to know that some good observers have recorded cases in which there were no vesicles, pustules, or papules, only the burrows, at the extremities of which were found the sarcoptes; the itching in these cases was as severe as in those attended with an eruption. In old persons, whose skins are thick and not very sensitive to irritants, the eruption is often trivial and papular in character. The disease is then not infrequently confounded with prurigo. The itching in scabies is very decided and severe, and greatly increased by warmth. The amount of inflammation and ulceration that may accompany the disease when it affects the delicate skin of young infants is likely to lead to a mistake as to its nature. Vesicles and pustules sometimes form under the thick cuticle of the sole of the feet, and are very characteristic of the disease.

Scabies never disappears spontaneously. I have seen cases where the disease has lasted for years, its nature having been misunderstood.

Prurigo and Eczema often complicate scabies; Urticaria less commonly, and in rare cases blebs form on the irritated parts.

Treatment.—Sulphur is the best remedy for scabies. It cures the disease by killing the sarcoptes. In the St. Louis Hospital at Paris, two hours' treatment is considered sufficient for the cure of the disease. The patient, after being well washed with soft soap for half an hour, is strongly rubbed for the same space of time over the whole surface with the sulpho-alkaline ointment of Helmerich, composed of eight parts of lard, two parts of sulphur, and one part of carbonate of potash, and directly afterwards placed in an alkaline bath. The patient's clothes are fumigated with sulphur.

The objections to this method of treatment are, that eczematous eruptions often follow its employment in persons with a delicate skin, and that the ointment stains the linen. The sulphur ointment of the Pharmacopœia does not cure so rapidly, although it does so quite as certainly as the sulpho-alkaline ointment. The great use of the alkali is to remove the superficial layer of epithelium, and so expose the sarcoptes more completely to the action of the sulphur.

Supposing that, from the position in life of the patient, it is desirable to hide the odour of the sulphur, the best scents for the purpose are the essences of bergamot and of lemons; a little bisulphuret of mercury will conceal the colour of the sulphur.

Devergie recommends, if the odour of the sulphur be highly objectionable, that the patient be placed for an hour, or an hour and a half, daily in a bath containing from two to three drachms of bichloride of mercury. Five or six baths, he says, suffice for the cure. Iodide of potassium may be substituted for the bichloride of mercury, but then more baths are required. Bazin advises, under like circumstances, that the surface be rubbed daily with an ointment composed of powdered camomile-flowers, lard, and olive oil, in equal parts.

When scabies is present, no matter with what other eruption it is complicated, the scabies is to be first cured, and this although the sulphur cause considerable increase of the complicating affection, *e.g.* Eczema.

BULLÆ.

There are two genera of the diseases of the skin characterised by an eruption of bullæ or blebs, viz. pemphigus or pompholyx, and rupia.

Pemphigus is not an uncommon disease. The bullæ are very perfect. In size they vary from that of a split-pea to half an egg; the larger are not formed by the coalescence of the smaller. If there be any red margin to the bullæ, it is very narrow; often there is no redness around. In some cases the bullæ are preceded by a red spot of the same size as the coming bleb; the bulla itself having its full circumference from the first, only being less elevated than it becomes in its progress. Sometimes, however, a vesicle appears, and the bulla is formed by its extension in all directions. At first the bulla is transparent; subsequently the fluid becomes opalescent and frequently puriform; at the same time, or it may be before the fluid loses its transparency, the cuticle covering it grows opaque. In the latter case the bulla looks as though it were filled with puriform fluid, and it is only by puncturing it that the chief cause of the opacity is discovered. In cachectic and aged persons the fluid is often sanguinolent.

The fluid of the bullæ in pemphigus resembles the serum of the blood in chemical composition. It is faintly alkaline or neutral so long as it is transparent; when it becomes puriform, it is acid. After attaining its full size the bulla bursts, then the cuticle covering it falls into folds or wrinkles, and, with such portion of the contents as has not escaped, dries and forms a scab. A few days only elapse from the eruption of the bulla to the formation of the scab. The scab or crust varies in thickness; usually it is thin, sometimes foliaceous, never very thick. After a time the scab falls off and leaves a reddish stain or scar, not a cicatrix. Now and then, when the scab is detached, a superficial ulcer is exposed. If the bleb be broken, and the cuticle removed, the surface is excoriated.

In rare cases only one bulla is present at the same time; bulla after bulla on different parts of the surface following each other in succession. This is the pemphigus solitarius of Willan. Usually there are many bullæ present at the same time, and they are either scattered or grouped. When many are seated near to each other, the skin between is usually red, and the lymphatic glands to which the lymphatics of the part lead enlarged and tender. This affection of the glands is out of proportion to the inflammation about the bullæ. The glands rarely, if ever, suppurate. The bullæ of pemphigus are more common on the extremities than elsewhere; but they are often seen on the trunk, genital organs, and face; less frequently on the hairy scalp. Rayer and A. T. Thompson say they have seen bullæ in the mouth and on the velum palati. There seems to be no foundation for the assertion that they are found on the gastro-intestinal mucous membrane.

When present on the soles of the feet or palms of the hands of infants, they are evidence of constitutional syphilis. Pain and heat of the part accompany the development of the bullæ.

Varieties.—1. Pemphigus may occur as an acute disease in young subjects otherwise healthy. The eruption is preceded for two or three days, and is accompanied by febrile disorder more or less decided. Under these circumstances, the disease runs a course of from one to four weeks. When prolonged for a month, two or three crops of bullæ follow each other; when over in a week, the disease ends with the scabbing of the first eruption.

The occurrence of idiopathic acute febrile pemphigus has been denied by some writers. 'That there is indeed such febris bullosa cannot henceforth well be doubted. Still Rayer's observation, that it is a rare disease, appears correct, since many physicians of large experience have never seen a case, *e.g.* Hebra. I also have never witnessed the acute form.'* The writer of this article has seen one case.

2. Persons of damaged health and old people also suffer from a severe febrile form of pemphigus, which runs a quick course.

3. More commonly, pemphigus occurs as a chronic disease, lasting months, or even years. This form of the disease is seen in persons of average health, in the cachectic, and at all ages, from childhood to extreme old age. It is unaccompanied by febrile symptoms; but as the chronic course the disease runs depends not on the duration of individual bullæ, but on the repeated eruption of new bullæ, we observe, when they come out in crops, that a little headache, sense of languor and malaise, and trifling febrile disturbance, precede the eruption.

Synonyms.—The names given by writers to the above varieties are founded, 1st, on the duration of the disease: acute pemphigus, febris bullosa, chronic pemphigus, pemphigus diutinus; 2nd, on the presence or absence of febrile symptoms: pompholyx pyreticus, pompholyx apyreticus; 3rd, on the degree of severity of the general disease: pemphigus benignus; 4th, on the number of the blebs and their arrangement: pemphigus solitarius, pemphigus en groupes.

Nature and seat.—The local affection in pemphigus is secondary to some constitutional or general condition. This is especially clear in the acute febrile variety; for in that form well-marked and sometimes very severe pyrexial symptoms, headache, and languor precede the eruption for two or three days. No doubt certain other symptoms are the direct consequences of the local affection; *e.g.* irritation from sleeplessness, derangement of the digestive organs. Of the nature of the general disease to which the local affection is secondary, we know no more than we know of the nature of the fever which precedes the eruption of small-pox. The fluid of the bullæ is poured out from the surface of the true skin, and collects under the epidermis. There is no evidence to show that the bullæ originate in any of the special structures of the skin.

The lesions found after death have been various evidences of inflammation of the intestinal and urinary mucous membranes, and in almost every case fatty liver.

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* Gustav Simon, *Die Hautkrankheiten*, p. 194.

Prognosis.—Pemphigus is always a grave affection. To the cachectic and aged it is often fatal. As a chronic disease it is most obstinate.

Diagnosis.—Varicella, herpes zoster, and rupia are the diseases said to resemble pemphigus. But there is little danger of confounding it with any other disease when the bullæ are present; their large size, the small amount of inflammation around them, the absence of any thing which can be called a base, and their irregular distribution, are peculiarities which permit no mistake in diagnosis. The fever which in rare cases precedes their eruption has no diagnostic characters.

Cause.—Of the causes of pemphigus very little is known. Mental distress, exposure to wet,—*e. g.* prolonged stay in water, —and derangements of the urinary organs, have all been considered to be predisposing causes. Attempts have been made several times, without effect, to communicate the disease by inoculation of the fluid from the bullæ. Scharlan, however, succeeded in producing bullæ by inoculating himself from an infant four days old, suffering from pemphigus. The child appears to have communicated the disease to several persons.* In this case the disease was probably of syphilitic origin. Febris bullosa, as acute pemphigus was formerly called, is said to have occurred as an epidemic, and then to have spread by contagion.

Treatment. Local.—Directly a bulla is detected, the cuticle covering it should be punctured with a fine needle. This stays its increase in size. Care must be taken to prevent the cuticle being rubbed off, as the surface exposed will be excoriated, painful, and tender. Dr. A. Todd Thompson recommends that the parts, after the escape of the contents of the bulla, should be pencilled with a solution of nitrate of silver, in the proportion of a drachm to a fluid ounce of water, acidulated with ten or twelve minims of dilute nitric acid. This solution hardens the cuticle and forms a good covering, he says, to the tender surface beneath it. All other local means are useless until scabs form; and then, if these are thick, and several are in juxtaposition, with the skin beneath ulcerated, a poultice of bread and water may be applied with advantage. If the ulcers do not heal after the separation of the crusts, they may be stimulated by nitrate of silver.

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* Caspar, *Wochenschrift für die gesammte Heilkunde*, p. 186, 1841.

The *general* treatment varies with the state of the constitutional disturbance and the general powers of the patient. If the patient be a strong young adult of temperate habits, the pulse full and hard, and the febrile disturbance considerable, benefit will follow abstraction of blood from a vein; but cases requiring, or even permitting, blood-letting are rare. Rest, mild aperients, and spare diet are usually sufficient, even in the acute febrile form, to bring the case to a successful termination.

When the disease occurs, as is more common, in the aged or the cachectic, bark and ammonia, quinine and the mineral acids, and generous diet, with a moderate supply of alcoholic stimulants, are indicated. Opiates at bedtime are frequently required.

In the chronic apyrexial form the treatment must be regulated by the general state of the patient.

Arsenic exerts little or no influence. Iodide of potassium is of use only when the disease is of syphilitic origin. Cod-liver oil is sometimes beneficial. Tepid baths have been of service; but occasionally fresh crops of bullæ have followed directly on their employment. If tepid baths are taken, gelatine should be dissolved in the water. Alkaline baths have been recommended for allaying the irritation of the surface. When successive crops of bullæ occur on the same part, the skin at the moment it is free from eruption may be painted with a solution of nitrate of silver sufficiently strong to blacken the surface.

A milk-diet has sometimes succeeded when other means have been useless. Cazenave says that he has often obtained good results from giving the patient acorn-coffee.

A case was some time since under the care of the author which resisted all remedies. The child would appear to be nearly well, and then again a new crop made him as sad an object as before. When admitted into the Hospital for Sick Children he had already been suffering for more than two years, and had been into more than one hospital, and under the care of several private practitioners, the parents being well-to-do in the world. He took measles while in the hospital, and from that time was free from pemphigus. There was no return of the affection for a year, *i.e.* when the last report of him was received.

Rupia.—The bullæ in rupia are small and somewhat flattened; their contents very soon become opaque, and are not unfrequently sanguinolent. They are seated on a *very* slightly raised base, and are surrounded by a distinct inflammatory flush. A thick dark-coloured rough scab or crust is formed by the drying up of the bullæ. If not forcibly removed, the scab remains attached for a considerable time. An ulcer, often deep and intractable, is exposed on the removal of the scab.

Sometimes the ulceration extends beyond the margin of the first scab before it is detached, and then a scab forms under the primary one, and of larger circumference; and this process is repeated until a conical crust, of considerable thickness in the centre, and an inch or more in diameter, is constituted. This crust is commonly and aptly compared to a limpet-shell. This variety of rupia is called R. prominens. It is evidence of a profound constitutional cachexia, in the majority of cases, if not in all, of syphilitic origin.

In other cases of rupia the ulceration is the marked feature. The scab is imperfect, and when detached an unhealthy-looking and spreading ulcer is exposed. This is R. escharotica. Sloughs occasionally form on the floor and at the margin of those ulcers; and then the disease has been mistaken for pemphigus, and called P. gangrenosus. In rupia simplex the crusts are of moderate thickness, and the ulcer which follows is neither deep, nor does it exhibit any tendency to spread. Neither scab nor ulcer is remarkable. Hebra holds that R. simplex always precedes R. prominens, *i.e.* that the latter is but an advanced stage of the former: and G. Simon thinks he is right. In fact there is no line of demarcation to be drawn between the varieties of rupia. The one passes by insensible degrees into the other.

Rupia is a chronic disease, and is usually limited to the limbs and loins. It is not contagious, and is almost limited to persons of damaged health. It is common in the cachectic state of the system which so often follows the acute specific diseases. Purpura hæmorrhagica is an occasional complication. Rupia prominens is frequent in the advanced stages of constitutional syphilis. R. simplex is common in children of six or seven years of age. R. escharotica and gangrenosa are limited to young children; the two latter are rare diseases. It is not known what special structure of the skin is primarily affected in rupia.

Rupia is more like to ecthyma than to any other disease of the skin. In ecthyma there are pustules; in rupia bullæ; but then the serum of the bullæ is soon replaced by a puriform fluid. The red base of rupia is much less raised and decided than that of ecthyma; the scab is thicker and not imbedded, and the ulceration following the scab is greater.

Treatment. Local.—The bullæ of rupia should be punctured as soon as they arise. When scabs are formed, they should be removed, and the ulcers dressed with some slightly-stimulating application. A solution of nitrate of silver is frequently of much benefit.

General.—The subjects of rupia are always cachectic or debilitated. Tonics, especially quinine, are indicated. Decoction of cinchona, with mineral acids, will sometimes agree with the patient when quinine will not. The tincture of serpentaria is sometimes very useful in rupia. The diet should be generous. Wine is generally required, and is borne well even by children.

PUSTULÆ.

*Impetigo,** one of the most common of the diseases of the skin, is characterised by an eruption of small pustules, followed by thick rough crusts. The pustules of impetigo are of two kinds; the one pale-yellow, flat or rounded on the surface, very slightly elevated above the cutis, and having comparatively little redness around; the other very small, acuminated, and having a red and somewhat elevated base, disproportionately large in comparison with the suppurating points; the latter are achores, the former psydracia. Achores are common on the face of children; psydracia on the scalp and other parts covered by long hair.

The pustules of impetigo are sometimes scattered at a distance from each other, sometimes grouped into clusters on a red ground; and the red ground in the latter case may precede the eruption of the pustules, as it does the eruption of the vesicles in herpes.

The crusts that follow the pustules are always thick; those that succeed to the achores are transparent and tenacious, and resemble in appearance inspissated honey and some kinds of gum; those that succeed the psydracia are either small separate, and dry, or, covering some extent of the surface, are thick, rough on the surface, and particularly solid.

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* Hebra considers all cases of impetigo, excepting impetigo sparsa of the extremities, to be forms of impeteginous eczema. The glandular enlargement is sufficient in many cases, however, to distinguish them, as is the strongly alkaline reaction of the fluid in all varieties of eczema.

The lymphatic glands, to which the lymphatics of the part lead, are invariably enlarged in impetigo. This enlargement of the lymphatic glands is not limited to those cases in which there is a considerable amount of inflammation or a copious eruption. A child brought to the physician because of the enlargement of one or more of the lymphatic glands of the neck will frequently be found to have an unsuspected spot or two of impetigo of the scalp. The achores and psydracia are alike accompanied by this glandular affection.

In very exceptional cases the suppurative inflammation destroys the root of a few of the hairs, and thus a very small bald spot remains after the crusts have separated. In the vast majority of cases not one of the roots of the hairs is destroyed. A certain amount of itching frequently accompanies impetigo; in extremely rare cases the pustules are exquisitely painful to the touch, and in still rarer cases intractable ulceration follows the separation of each crust.

The pustules characteristic of impetigo are produced by inflammation of the hair-follicles, terminating in suppuration. Impetigo is thus anatomically and pathologically defined as suppurative inflammation of the hair-follicles. The difference between achores and psydracia is probably due to the anatomical differences of the hair-follicles of the face and those of the perfect hair-producing parts or on the relative proportions of the hair-forming follicle proper and of the sebaceous structures which enter into the composition of the perfect hair-follicle. On the hairy scalp the achores are almost limited to the occipital region, and especially to that part corresponding to the interval between the insertion of the muscles.

Achores are far more common in the child than in the adult.

The admitted varieties of impetigo are due—to the seat of the disease (thus we have Impetigo faciei and I. capitis);—to the close approximation of the pustules on a defined inflamed surface, or to their being scattered at a distance from each other, the space between being pale (these differences have given origin to the names I. figurata and I. sparsa);—to the character of the inflammation which precedes and accompanies the acute development of the pustules of certain cases of I. figurata (hence the variety I. erysipelatoides);—to the thickness and extent of the crust which follows (when the face is covered by a thick crust, the variety is I. larvalis; when a thick crust covers a large surface of an extremity, it is I. scabida—this latter is limited to adults: 'In the lower extremities,' Bateman observes, 'the disease is most severe and obstinate; is ultimately conjoined with anasarca, and often produces severe ulceration;'* when the crusts are small, dry, and adhere for some time to the hair after they have separated spontaneously from the cutis, the disease is termed I. granulata);—to intractable ulceration following the pustules (it is doubtful, as has been suggested by Cazenave, whether I. rodens, as this variety is named, would not more correctly be placed as a species of lupus);—to the duration of the disease, e.g. I. acuta, I. chronica. Acute impetigo is not usually preceded by any great constitutional derangement. An inflamed patch pretty well defined precedes the eruption of the pustules. Acute impetigo is always also I. figurata, though I. figurata is sometimes a chronic affection. The duration of acute impetigo is from two to three weeks. Chronic impetigo sometimes lasts for years. The two most obstinate forms are impetigo sparsa of the beard, whiskers, moustache, and inside of the nares; and impetigo scabida of the lower extremities. In the former case the duration is due to the repeated eruption of fresh pustules; in the latter to the continuance of the formation of pus under the old thick crust. No disfigurement to the face results from the most severe impetigo. The crust after a long or shorter time separates, leaving merely a reddish stain, which quickly disappears.

Willan figures six varieties of his genus porrigo: of these—
P. larvalis and P. favosa are merely varieties of impetigo.
Porrigo furfurans is a species of eczema.
Porrigo scutulata is tinea tonsurans.
Porrigo lupinosa is tinea favosa, and
Porrigo decalvans is tinea decalvans.

Bateman's description of porrigo scutulata is most confused; it certainly does not apply to Willan's figure. The latter is a faithful portrait of a common disease: the former applies to no known disease of the scalp, but to separate stages of many diseases having no relation chronologically or pathologically to each other. No age is exempt from impetigo, only I. faciei and I. capitis are more common in children than in adults; while impetigo of the extremities is far more frequent in adults.

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* *Practical Synopsis of Cutaneous Diseases*, p. 158.

The inflamed lymphatic glands occasionally suppurate in children of a strumous diathesis, and when the seat of tubercle.

The characters by which tinea sycosis or mentagra is distinguished from impetigo are well given by Cazenave.

'When impetigo,' he says, 'is limited to the upper lip or chin, it may be mistaken for sycosis; but in the former the pustules are small, arranged in groups; they suppurate completely, and give rise to the thick crusts: while in sycosis the pustules are distinct; they suppurate to a small part of their extent only—a sixth or eighth, for example; they give rise to a dry, hard, black scab, which is subsequently, as it were, suspended on the middle of the hair; and finally they are succeeded by tubercular indurations, which constitute a secondary phenomenon of the greatest importance.

The pustules of ecthyma are larger and seated on a base. The crusts of tinea favosa are dry, of peculiar shape, and a microscopic examination shows their vegetable nature. The vesicles of eczema have no connection with the hair-follicles, though the inflammation may involve the hair-follicles of the part, and so eczema and impetigo be combined as in one variety of eczema impetiginodes. The crusts of eczema are thin and pale, and when they crack, oozing of a thin alkaline fluid takes place. The pus of impetigo is slightly acid.

Impetigo appears to be contagious. It is very common to see several children in the same family suffering at the same time. It does not spread, however, as tinea tonsurans so often does, through a large assembly of children, *e.g.* a school. Impetigo evidently spreads by contact, and the pus cannot be wafted, as the spores of the trichophyton can, from one to another. The usual medium of conveyance of the pus of impetigo from one child to another is some article of wearing-apparel, *e.g.* a cap or bonnet. Children suffering from impetigo of the head or face often have impetiginous pustules on their fingers from picking the parts primarily affected. Cazenave denies any form of impetigo to be contagious. Willan and Bateman thought that form alone contagious which is characterised by the eruption of achores. Dirt is a very common exciting cause of impetigo, so also are sugar and stone-dust; the foreign particles collect in the orifices of the hair-follicles, and suppurative inflammation of the follicles is the result. Impetigo of the occiput, Mr. B. Squire says, is always due to pediculi. Impetigo shows no special tendency to affect the weakly or the strumous, and is certainly rare in the rickety. It is an infrequent syphilide.

Treatment.—In the acute form, a mild aperient, salines, and a simple unstimulating diet, with tepid water as a local application, are generally all the remedies required. When the disease has lasted some time, all crusts must be removed, either by the steam of hot water, or by bread-and-water poultices. It is frequently necessary to remove the hair in order to get the crusts away. The head cannot be shaved; but with a pair of fine scissors the hair can be cut close to the scalp. Patience is needed for this purpose, if the greater part of the scalp be affected. After the removal of the crusts, spermaceti ointment or washed lard, or sweet-oil and soap and water, night and morning, often suffice to effect a cure of masses of most repulsive-looking disease. Should these means fail, and new pustules continue to appear, a brisk mercurial aperient, *e.g.* calomel and jalap, or calomel and colocynth pill, followed by a grain of quinine three times a day, with ten or fifteen minims of dilute sulphuric acid, will quickly bring the great majority of cases to a successful end. Quinine often seems to act almost as a specific. After the separation of the crusts, a stimulating ointment is sometimes required to prevent the continuance of suppuration. Unguentum zinci; ung. hyd. nitratis; ung. hyd. nit. oxid.; ung. sulph. iodid.; and ung. sulphuris hypochloritis, are all occasionally useful, and one will sometimes answer when the others have failed, and without the reason being apparent.

Several doses of alterative aperient may be required in the course of the treatment. In obstinate cases the waters of Harrogate and those of Aix-la-Chapelle have been found of much service. In impetigo of the parts on which the whiskers, beard, and moustache are seated, and of the inside of the nares, epilation is often essential for a cure. The moment the slightest swelling or redness is seen at the point where a hair emerges from the skin, it should be removed. The inner root-sheath comes away with the hair; and if examined microscopically, the epithelium thus detached is found to be swollen; and often where no trace of suppuration is visible externally, pus-globules are found between the hair and the inner root-sheath. When the hair is pulled out, the pustule aborts, as it is termed. The iodide-of-sulphur ointment, and a lotion composed of bichloride of mercury two grains, and bitter-almond emulsion one ounce, are the best local applications. Care must be taken to prevent children tearing off the scabs with their nails. The parts itch and feel stiff; and consequently it is with difficulty children are kept from affording themselves temporary relief by picking and scratching the part.

Ecthyma.—The pustules by which ecthyma is distinguished are the phlyzacious. They are large: rarely, however, exceeding a pea in size; with red, moderately-elevated, and hardish base. Each pustule is followed by a brown scab, which is very adherent to, and somewhat sunken or imbedded in, the hard base. The scab forms two or three days after the eruption of the pustule. When the crust separates, a deep red stain, a small ulcer, or a cicatrix remains.

Ecthyma runs an acute or a chronic course; the former is, however, comparatively rare.

The acute form is preceded by slight constitutional disturbance, loss of appetite, and deranged alvine secretions; rarely by febrile symptoms. The pustules are generally limited to a small part of the surface; the shoulders and neck are their most common seat. A sharp, burning, pricking pain often precedes the eruption of the pustules. In very rare cases several of the pustules coalesce. The lymphatic glands to which the lymphatics of the part lead are usually enlarged.

The duration of acute ecthyma is one to two weeks. This is the ecthyma vulgare of Willan.

The pustules of chronic ecthyma are scattered at some distance from each other. They are most frequently seated on the extremities, now and then on the extremities and trunk; and in infants they are seen also on the hairy scalp. The long duration of the disease (several months) is due to the eruption of crop after crop of pustules. When the disease affects persons of broken-down health, the pustules are often filled with a reddish sero-purulent fluid; the areola instead of being red is dusky or purple; and ulceration of an unhealthy character follows the separation of the scab: this is E. cachecticum.

No variety of ecthyma is contagious.

Chronic ecthyma indicates a low state of the constitutional powers; and E. cachecticum occurs only in the aged and those exhausted by bad diet, over-exertion, mental distress, and other depressing causes. E. cachecticum is sometimes accompanied by purpura hæmorrhagica, and then the areola is purple. This variety has been called E. luridum.

Ecthyma chronicum occasionally follows the acute specific diseases. Pregnancy is said to be a predisposing cause of the disease. It is one of the most common of the syphilides.

Ecthymatous pustules are produced by the application of various irritants to the surface. The grocer's itch, as it is called, is produced by the irritation of sugar. Stonemasons now and then suffer from the same disease. The well-known pustules that follow the inunction of tartar-emetic ointment are examples of ecthyma; only the pustules resulting from the application of this agent are umbilicated.

Scabies is often complicated, especially in young children, by large ecthymatous pustules; as are also, though much less frequently, prurigo and lichen.

The special structure of the skin which is primarily affected in ecthyma is unknown. Biett said that the inflammation originates in the sebaceous follicles: Hilbert and G. Simon, that when tartar-emetic is applied to the skin, the orifices of the hair-follicles are first affected; and they attribute the umbilication to the tying-down of the centre of the pustule by the hair-follicle.

Treatment.—In the acute form of ecthyma little is required to be done. One or two doses of alterative aperient, followed by simple salines; a simple but not too low diet; and tepid water frequently applied to the inflamed part, are all that are necessary and useful.

In the chronic forms the health is generally and sometimes very much deranged; the patient weak and exhausted. Generous diet, moderate quantities of wine, quinine or bark, and the mineral acids, serpentaria, and cod-liver oil, and steel, are one or all necessary to effect a cure. Daily tepid baths are useful. Taraxacum and sarsaparilla, with nitro-muriatic acid, seem occasionally to be of much benefit. Opiates are sometimes required at night.

PAPULÆ.

Strophulus, or red gum, as it is vulgarly called, is a common papular disease proper to children from birth to the end of the first dentition. It is characterised by the eruption of small papulæ, red or paler than the healthy skin, scattered or grouped, and attended by trifling itching.

Many writers on diseases of the skin consider strophulus and lichen to be the same disease.

Several varieties have been described, and most admirably figured by Willan. When the papules are scattered over the skin with small red spots interspersed among them, the disease is called S. intertinctus. When the papules are crowded into groups, and the skin between is more or less red, it is S. confertus. 'Sometimes,' Bateman says, 'though rarely, a variety of the S. confertus appears on the legs, spreading upwards even to the loins and navel, producing a general redness of the cuticle (not unlike intertrigo), which cracks and separates in large pieces, occasioning much distress to the child. It is liable to recur at short intervals for the space of two or three months.' It is in children of seven or eight months old that this severer form of S. confertus occurs. When, for three or four weeks, circular patches of papules appear in succession, each patch lasting four or five days, the disease is S. volaticus.

Strophulus candidus is the name applied to an eruption of white, rather large papules, which appear occasionally on the loins, shoulders, and upper arms of children of about a year old. There is a danger of mistaking the hard pale elevations produced in some children by the bite of a flea for this disease; a vesicle sometimes results from the bite of the same animal.

Strophulus albidus is a rare disease. It is doubtful if Bateman (judging from his description) ever saw a case. Willan's figure is perfect. The so-called papules are really sebaceous follicles, distended by their secretion. The small elevated opaque dead-white spots scattered in numbers over the face are so striking in appearance as at once to rivet the attention.* Willan's strophulus albidus is, then, a form of acne. Hebra it was who pointed out the real nature of this affection.

Strophulus is a disease of no practical importance. It is not contagious. It generally depends on some disorder of the stomach and bowels of the child; this being itself often secondary to dental irritation, or to improper diet.

Treatment.—A knowledge of the causes of strophulus points to the treatment. A gentle antacid aperient, as rhubarb and magnesia with an aromatic; or an antacid without any aperient, as the mistura cretæ, should be given; attention should be paid to the diet, which is so often faulty in the child, and the use of the gum-lancet may be required. The eruption is of use, by pointing the attention to some error which, if allowed to go on uncorrected, might lead to more serious trouble. It is only in the gravest form of S. confertus that occasional bathing with faintly alkaline gelatine water is required.

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* In University-College Museum there is an excellent wax-model, by Mr. Tuson, of the face of a child suffering from this disease. It was made from a patient of the writer's.

Lichen.—The papulæ of lichen are very small solid elevations of the cutis, perceptible to the touch, redder than the adjacent skin, which cannot be even temporarily removed by pressure, though they may be made for the instant paler. The papules itch and tingle. As the redness fades, and the papules disappear, trifling desquamation of the cuticle over them takes place. Lichen commonly affects a limited part of the surface only, *e.g.* the hands, fore-arms, trunk, face. The back of the hands and the outer aspect of the fore-arms are common seats. The papulæ are generally arranged in groups.

Lichen occurs in an acute and in a chronic form. Lichen simplex is accompanied, and sometimes preceded, by trifling febrile disturbance. The papules are bright in colour, and appear first on the face and arms, then extend to the trunk and lower extremities; it is an acute affection, lasting from ten to twenty days. It has been mistaken for measles and for scarlet fever. L. simplex occasionally returns at long intervals in the same individual.

Lichen circumscriptus, L. urticatus, and L. lividus, may be regarded as chronic varieties of lichen simplex.

In lichen circumscriptus the papulæ are arranged in irregularly circular groups. As those first evolved fade, others appear at the margin of the patch; in this way the disease may be prolonged for many weeks. Lichen gyratus, in which the papules are arranged so as to form a twisted band, is probably a form of lichen circumscriptus of syphilitic origin.

Lichen lividus is seen in old persons, and chiefly on the lower extremities. The papules are dusky red, or livid, and frequently purpuric spots are interspersed among the papules. Hebra considers it to be a species of purpura, and calls it purpura papulosa.

In lichen urticatus the more permanent papules are preceded by small wheals; the papules becoming apparent as the wheals subside. The papules are throughout the whole course of the attack larger than in any other variety of lichen. Hebra and G. Simon consider it to be a variety of urticaria, and call it urticaria papulosa.

Lichen pilaris is distinguished by the passage of a hair through the centre of each papule. It is probable that it would, as G. Simon has stated, be more correctly described as a variety of acne.

Lichen agrius is a much more serious variety. A considerable amount of local inflammation attends the eruption of the papules, which are usually limited to circumscribed patches of some extent. The heat, tingling, and itching are very troublesome, and the scratching to relieve the last-mentioned symptom increases the local inflammation. Warmth and internal stimulants, alcoholic or other, increase the itching. Lichen agrius may disappear in a fortnight or three weeks; usually, however, it runs a chronic course, crop after crop of papules appearing on the inflamed patch. Ultimately the skin of the part becomes thickened and cracked; a serous oozing may take place from the surface abraded by the nails, and suppurative inflammation may be set up, and then crusts of various degrees of thickness are formed on the surface. Lichen agrius in this state may be mistaken for psoriasis, for eczema, or for eczema impetiginodes; and it is only by the history, and by a careful examination of the margin of the patch, that the primary nature of the affection can be determined.

The prickly heat of hot countries is merely an aggravated form of lichen simplex. It is called lichen tropicus.

Hebra has described a very rare form of lichen to which he has given the name L. ruber. At first there is an eruption of miliary papules; the eruption is accompanied by very little itching. The papules increase in number till they occupy entire regions or even the whole surface of the body. The appearance of the disease is then quite peculiar. The integument is universally reddened, covered with numerous thin scales and so infiltrated that when a fold of the skin is taken up it is found to have more than twice the normal thickness. The flexion of the joints may be impeded by the thickened skin. As the disease spread over the whole surface the patient falls into a state of marasmus, and the case generally ends fatally.*

Lichen is not contagious. Persons of a nervous excitable temperament are specially liable to it. Women more frequently suffer than men. It is more common in spring and summer than in autumn or winter. Some derangement of the stomach or intestines is usually connected directly with the attack.

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* *Sydenham Society's edition of Hebra*, vol. ii.

The investigations of Gustav Simon seem to prove that the papules of lichen, strophulus, and prurigo are not, as some have asserted, the papillæ of the skin inflamed or enlarged. They have no connection with the papillæ; but are produced, according to the same observer, by the effusion of serosity into the substance of the skin. Lichen, strophulus, and prurigo are considered by Cazenave to be primarily lesions of sensibility—true nervous affections; the degree of itching bearing, he says truly, in many cases no relation to the number of the papules.

Treatment.—A mercurial at bedtime, followed by a saline aperient in the morning, once or twice a week, a carefully regulated, simple, unstimulating diet, the avoidance of heating exercises and clothing, a well-ventilated room, and a gelatinous or mucilaginous bath every night to allay irritation, will bring the majority of cases of lichen to a favourable termination. When the inflammatory symptoms have been reduced, and the disease has assumed a chronic form, arsenic will effect a cure. Fowler's solution (liquor potassæ arsenitis) in five-minim doses may be given three times a day. Sulphur-baths have proved useful in some cases. It is rarely that local stimulating applications are of service. Ointment containing calomel and camphor, and iodide of mercury, are recommended by Rayer; but certainly prove injurious in the great majority of cases which seem best suited for their employment.

Bark with dilute sulphuric acid, and a generous diet with wine, are the proper remedies in lichen lividus.

The most obstinate forms of lichen are L. pilaris and L. urticatus. In the treatment of the former the inunction of lard every night, followed by an alkaline bath, soap and water, and friction, are most useful. Sponging the parts with vinegar and water, or lemon-juice, will sometimes allay the intolerable itching in L. urticatus. The subjoined lotion is recommended by Dr. Thompson for the same purpose:

℞ Acid. hydrocyan. dil. ʒjss.; potassæ liquor. ʒj.; aq. rosæ ℥ vss. M. This lotion to be applied to the part when the itching or pain are troublesome. For L. ruber the remedy is arsenic in full doses.

Prurigo is characterised by a scattered eruption of very slightly raised, flat, and rather broad papulæ, differing little, if at all, from the colour of the skin. These papules are the seat of troublesome itching. It is sometimes very difficult to detect the papules, in consequence of their colour, their flatness, and their breadth. Sometimes they appear, as it were, buried under the cuticle, and the papules which can be discovered by the most careful examination are often very few compared with the severity of the itching. Stimulating drinks, spices, heating exercise, trifling contact of the clothes, and change of temperature increase this most troublesome symptom. Sometimes the patient, comparatively free during the day, no sooner is warm in bed than the itching becomes so intolerable as altogether to prevent sleep. The excessive itching of the papules never fails to lead to their apices being torn by the nails. Blood and serosity ooze from the abraded surface, and a little black crust occupies the summits of many of the papulæ. The lines of abraded cutis, so common in scabies, are comparatively rare in prurigo. In the latter it is the papule itself which is torn. When the itching is accompanied, as it sometimes is, by a sensation as of insects crawling over the part, the disease is called prurigo formicans. This is a most obstinate and severe variety. Wheals of urticaria occasionally appear when the part is rubbed or scratched violently. Prurigo is common in the aged: the itching being most constant and severe, the patient having little rest day or night. When prurigo occurs in old people, it is called P. senilis. By the irritation and want of sleep it occasions, P. senilis has sometimes shortened life. It is in old persons especially that the papulæ most easily escape detection. Prurigo formicans and P. senilis are usually very obstinate, lasting months and even years. When the itching is moderate in severity, as is not unfrequently the case in young persons, the disease is P. mitis. This variety disappears in from a few hours to a few days.

There is no line of demarcation to be drawn between these three varieties of prurigo. The greater or less degree of itching and the age of the patient are very insufficient grounds for the foundation of species. Hence it has been proposed to divide prurigo into general and local prurigo.

The shoulders, neck, and outer aspect of the arms, are the most common seats of prurigo.

Old persons who suffer from prurigo are also frequently the subjects of lice; and it has been supposed that the condition of skin on which the prurigo depends is favourable to the propagation of the lice. G. Simon, on the contrary, thinks that it is in many cases the rubbing and scratching of the skin consequent on the presence of the lice which induces the papular eruption. No doubt the want of cleanliness, so common in old age, is a cause for the presence of the parasite and of the eruption.

The papules of prurigo bear a close resemblance to those of scabies; and cases of scabies, in which vesicles are few and not very perfect, have repeatedly been mistaken for prurigo. Bateman says P. mitis often terminates in scabies: he might more correctly have said scabies is often mistaken for prurigo. 'As to the changes of the skin in prurigo, I,' writes G. Simon, 'endeavoured to satisfy myself by the examination of papules, which I cut, with a small piece of the adjacent skin, from living people; and I found exactly the same state as in lichen. The epidermis was not detached, the papillæ of the skin were not enlarged, and the fibres of the cutis were unchanged.' He concludes that the papule in prurigo, as well as in lichen, is produced by the presence of serosity in the substance of the skin at this spot. If a papule of prurigo be punctured with a fine needle and then compressed, a clear fluid oozes from the wound; if a papule of lichen be punctured with equal care, blood escapes. Simon attributes the difference to the greater vascularity of the papules in lichen, and the consequent impossibility of not puncturing a vessel. The little serosity that would otherwise be visible is concealed by the blood. Hebra says each papule is formed by a collection of fluid in the deeper layers of the epidermis.

Prurigo, like lichen, is considered by Cazenave to be a disease of sensibility. Of the origin of the nervous affection, nothing is known. The retention of some of the urinary constituents in the blood has been stated, but hitherto without proof, to be a cause of prurigo. The itching of the skin in jaundice is familiar to all; and in some cases in which that symptom has been most marked, a papular eruption has been present. Whether in these cases the papular eruption is the consequence of the scratching, it is impossible to say. The subjects of prurigo often suffer from hæmorrhoids.

Treatment.—If the patient be young and strong, the diet should be simple and unstimulating, and the bowels kept freely open by such a mixture as the following, taken two or three imes a day: ℞ Magnes. sulph. ʒjss.; acid. sulph. dil. ♏xv.; nf. gentian. co. ℥jss. Misce. A dose of calomel and colocynth, or blue-pill and colocynth, should also be given at bedtime once or twice a week. Tepid alkaline baths should be used every other night. Sulphur-vapour baths are useful when aperients are no longer indicated by the pulse and general state of the patient. Sea-bathing has sometimes effected a cure.

In the aged, and in young persons of broken health, good diet and even wine are required. Tonics, especially quinine or bark with mineral acids, are useful. Frequent washing with soap and water, and daily change of body-linen, are essentials. Tepid alkaline baths and sulphur vapour-baths are also of much service. Diuretics and cholagogues have been given when the disease has been supposed to depend on the retention in the blood of the urinary or hepatic secretions.

Cazenave says, that since lichen and prurigo are really true neuralgic affections, they should be treated as such. And he adds that the practical results he has obtained afford fresh proof of the correctness of his views as to the nature of these most troublesome affections. ‘In the majority of cases the employment of antispasmodics or of antiperiodics suffice,’ he says, ‘to modify completely the hyperæthesia. I have had recourse,’ he adds, ‘with happy results to ammoniacal sulphate of copper, to datura-stramonium, to extract of aconite.’ The last he gives thus: ℞ Extract. aconit. gr. xv.; conf. rosæ q. s. ut ft. pil. xx. One pill night and morning. Sulphate of quinine he gives in doses of from 3 to 5 grains per diem, and continues it for one or two weeks. Of Fowler's solution (liquor potassæ arsenitis), in common with all writers on this subject, he speaks in the highest terms; but he considers that it acts not only by modifying the action of the skin, but also as an antiperiodic.

Local prurigo.—There are many species of local prurigo, but they differ only in their seat: thus there are P. podicis, scroti, pudendi, præputii, urethralis, &c., according to the part affected.

Local intolerable itching is always called prurigo; but it is by no means always the consequence of a papular eruption. Itching of the anus and of the labia pudendi is a common consequence of congestion of the large veins of the part, of hæmorrhoids, of ascarides in the rectum, of an overloaded lower bowel, of the early stage of cancer of the uterus and lower bowel. Local eczema is a common cause of intense itching.

Treatment.—Cleanliness and the avoidance of scratching are the first essentials to a cure. If the anus be the seat of the trouble, it should be washed after stool and then carefully dried. The liver and bowels should be freely unloaded, in order that all congestion of the parts due to impediment to the onward flow of the blood in the portal vein may be removed. Leeches to the anus are often useful when it or the parts in its vicinity are the seat of the prurigo. Tepid water, or lotions containing an alkali, opium, prussic acid, acetate of lead, calomel and lime-water, acetate of ammonia, vinegar, have all been used with advantage, and have all failed in other cases to afford relief. The bichloride of mercury and lime-water, two grains to the ounce of lime-water, is one of the most efficacious local applications. Ointments containing lead, nitrate of mercury, or ammonio-chloride of mercury, sometimes check the itching when the lotions recommended have proved useless. The patient should always keep the preparation which answers best by his bedside, so that when the heat of the bed renders the itching severe, he may bathe or anoint, instead of scratching, the part. When eczema is the cause of the itching, a solution of nitrate of silver and the ung. sulphuris-hypochlor. are the most frequently successful applications.

SQUAMÆ.

Pityriasis.—Trifling redness of a limited portion of the skin, with furfuraceous desquamation of the cuticle covering the part, are the characters by which pityriasis is known. Pityriasis capitis is the most common variety. This is the disease known to the nurses by the names scurf and dandriff. The head itches, and directly it is rubbed, quantities of little scales, formed of epithelium, are detached. A similar affection occasionally occurs at the bends of the joints and over a limited extent of the trunk. When it has existed for some time in a severe form on the head, the hair often comes out in considerable quantity. It grows thin, but does not come off in patches, or to such an extent as to cause baldness.

Pityriasis rubra is the name applied to the disease when the redness is more decided, and there is roughness, rather than detached scales, on the surface. It occurs in patches. The most common exciting causes of P. rubra are exposure to the rays of the sun or to a cold dry wind; and frequent wetting of a part of the skin and then drying of it by evaporation. Children often produce pityriasis rubra of the lips by wetting the surface of the skin around the mouth with the tongue. No doubt many of the cases called pityriasis rubra are really examples of the driest forms of eczema.

Treatment.—A solution of borax as a detergent, mild astringent ointments, and the avoidance of hard friction, as by the use of a hard hair-brush, are usually all that are needed in the treatment of pityriasis capitis. If these means fail, or if the disease be very troublesome, the following liniment will be found a valuable aid: ℞ hydrarg. ammon. chlorid. ʒj. : ol. olivæ ℥j. M. To be applied to the head with a camel-hair pencil. When the hair falls out, a local stimulant often stays the mischief. Equal parts of acetum cantharidis and spirits of rosemary form a good liniment.

In pityriasis rubra, zinc ointment and the avoidance of exposure to the exciting cause generally effect a cure.

Aperients are frequently required. In severe, extensive, and obstinate cases of pityriasis rubra, vapour and sulphur baths are often useful.

Psoriasis.—The disease now commonly known by the name of psoriasis was formerly, and is still by some, divided into two genera, viz. psoriasis and lepra. This distinction is based on no real difference between the two affections.

Psoriasis is a chronic disease characterised by slightly-raised red patches covered by white shining opaque scales.

The varieties of psoriasis are founded on the shape, size, number, or situation of the patches. Thus, when the spots are circular, small, numerous, and irregularly scattered over the skin, the disease is P. guttata; when they are long and broad, it is P. diffusa; when they are ring-shaped, the centre assuming a healthy appearance while the disease is spreading at the circumference, it is P. vulgaris or P. circinnata. It was to patches of psoriasis of this shape that the name lepra vulgaris was applied. When the patches are in the form of twisted bands, a very rare variety, it is called P. gyrata.

As to the varieties named merely from the part affected, there are P. præputialis, scrotalis, labialis, palpebrarum, palmaris, dorsalis, &c.

Psoriasis in all its forms runs a very chronic course, lasting not infrequently for many years. When cured, it is prone to recur. Some persons have an attack of psoriasis every year, some two in a year. Spring and autumn are said to be the seasons when these attacks occur.

The spots of P. guttata are from a quarter to half an inch in diameter, their centres are raised, and as they fade their centres heal first. P. guttata occurs on the trunk and extremities. The spots are often irregularly scattered over the whole surface. It is common for a few spots to be present in other varieties of psoriasis. The twisted bands of P. gyrata are said to be formed by the close approximation of separate spots of P. guttata.

P. diffusa begins in rather broad irregularly-shaped angular patches, which subsequently coalesce. Its most common seat is the extremities. The front of the leg, from the patella to the ankle, is occasionally covered with an unbroken patch of P. diffusa. The outer aspect of the forearm, from the elbow to the wrist, is also now and then the seat of a similar large patch. When P. diffusa is very severe and long continued, it has been called P. inveterata.

When the ring-shaped patches of P. vulgaris attain a very large size, the scales are sometimes wanting over a considerable extent of the ring. Under such circumstances there is a large red elevated ring, with patches of scales here and there. Within this ring are occasionally rings of P. vulgaris entirely covered with scales. The local accumulation of scales in psoriasis of the scalp is often enormous. When psoriasis affects the backs of the joints of the fingers, most painful cracks form; the scales in this situation are few. The itching is very troublesome in some forms of psoriasis, attaining its maximum when the disease affects the scrotum or the labia pudendi.

Dr. McCall Anderson, in his work on psoriasis and lepra, has described a form of psoriasis in which the scales are very thick, and so much thicker in the centre of the patch than at the circumference as to give to the patches on a superficial examination the appearance of crusts of rupia.

The red patches of psoriasis are due to inflammation of the cutis; the scales to excessive formation of epithelium on the inflamed surface.

Neuman (*Wochenblatt der Gesellschaft*, 1867) from his minute researches into the local structural changes in psoriasis, concludes that psoriasis is an affection of the skin involving chiefly the papillæ and the superficial layer of the corium, of which the characteristic feature is the excessive formation of epidermis.

Inflammation of the skin, attended by the effusion of the ordinary products of inflammation, leaves behind, supposing the patient to be disposed to the disease, a state of the part favourable to the formation of a patch of psoriasis.

Thus a lad was in University College Hospital suffering from psoriasis. The disease had almost disappeared, when herpes zoster occurred, ran its ordinary course, and healed; but no sooner had the scabs separated, and that stage been reached in which only a faint red stain indicates the seat of the herpetic patches, than each reddish spot covered itself with scales,—in fact was converted into a patch of psoriasis. A blister was subsequently applied to the lad's thorax. When it had healed, and the stage of simple redness was reached, the part on which it had been placed covered itself with scales. It may be, of course, that the herpetic inflammation and the inflammation excited by the blister acted especially by stimulating the vessels or the nerves or the formative power of the part. Probably all were affected; the formative power being disproportionately affected from the general state of the health.

As bearing on this question, it is interesting to note that, in P. guttata, if the points at which the spots are originating be carefully sought out and examined, the redness and the scales will be seen to be forming at the orifice of the hair-follicles, not in all instances, but in the majority.

Psoriasis occupies the drier and coarser parts of the skin. Hence it is most common on the knee, just under the patella; and at the elbow, on the skin covering the olecranon process of the ulna. In regard of situation, it occupies the parts which differ most in texture from those occupied by eczema. When the patches are very numerous or very large, and spread from the back to the front of the arm, or from the front of the knee to the ham, the disease is worse or more extensive in the coarser-textured parts. Thus parts at which the sweat-glands are the most abundant are the chosen seats of eczema, while the same parts are rarely the seat of psoriasis.

The loins, according to Mr. B. Squire, are more frequently affected than any other parts of the trunk.

Psoriasis is often connected with deranged stomach, and especially with a very subacute gastritis.

It is never communicated from one person to another. A tendency to psoriasis is undoubtedly hereditary. Psoriasis is a common syphilide. Whenever it affects the soles of the feet or the palms of the hands, the probability of its origin in constitutional syphilis should be investigated.

Care must be taken not to confound eczema of the palms of the hands with psoriasis of the same part. There is occasionally a difficulty in separating the two. In fact, eczema of this part is occasionally figured as psoriasis; the thickness of the cuticle prevents its being raised into vesicles, the fluid formed is small in quantity and escapes notice; the consequence is that the chief feature of the case is the peeling of the skin of the palm. The most frequent exciting cause of the eczema, viz. carbonate of soda, used by women in washing, &c., so changes the cuticle as to aid in the production of a similarity between the two affections. Excluding, then, the syphilides, psoriasis of the palm of the hand is a much rarer disease than is generally supposed, and non-syphilitic psoriasis of the soles of the feet is very rarely, if ever, seen.

The drier forms of eczema of the neck, extremities, and trunk are occasionally mistaken for psoriasis. The different situation occupied by the two diseases suffices at once to prevent the error, by suggesting a doubt as to the case being what it at first sight resembles. A careful examination of the part shows the apparent scales of eczema to be formed of dried vesicles.

Treatment.—Attention should in all cases of psoriasis be paid to the state of the stomach, in order that any thing approaching to subacute gastritis may not escape observation. Should it be indicated, then the diet must be carefully regulated, and this internal affection made the first object of treatment. In cases where there is no evidence of an inflammatory state of the mucous membrane of the stomach, the treatment is determined by the state of the local disease, and by the general condition of the patient; if the patches be hot and bright red, an antiphlogistic regimen and venesection, or aperients, or both, according to the age, the pulse, and the strength of the patient, are to be first employed. Should there be no unusual heat of the part from the first, or after the active symptoms have been subdued by the remedies above mentioned, liquor potassæ, iodide of potassium, tincture of cantharides, and especially arsenic in the form of Fowler's solution, are the most potent internal specifics. Liquor potassæ and iodide of potassium require to be given in full doses in a large quantity of some bland fluid.

Tincture of cantharides, an old remedy, was employed by Biett, who thought very highly of it, and by it alone cured a large number of obstinate cases. The dose to commence with is five minims twice a-day; it may be gradually increased till thirty or forty minims are taken, in divided doses, during the day. Its action must be carefully watched. Nausea, colic, diarrhœa, and troublesome erections of the penis, are said by Cazenave to be the occasional consequences of its employment.

Arsenic, however, is undoubtedly the most potent of the remedies used in the treatment of all varieties of psoriasis. The dose of Fowler's solution is three minims three times a-day, gradually increased till eighteen or twenty minims are taken, in divided doses, during the day. Each dose should be taken on a full stomach, *i.e.* directly after meals. Its effects must be attentively watched. When any signs of its disagreeing occur, it should be omitted for a few days, and then resumed in smaller doses. The evidences of too strong action are inflammation of the tarsi, ophthalmia, nausea, colic, diarrhœa, and a troublesome dry paroxysmal cough. Other internal remedies which have been said to be occasionally of service are the decoctions of dulcamara and of mezereon, bichloride of mercury, calomel, and pitch. The decoction of dulcamara may be used with advantage as a vehicle for the more potent tincture of cantharides and liquor potassæ arsenitis. Copaiba in small doses, originally recommended by Hardy, is said to have proved efficacious in cases not benefited by arsenic. (Liveing, *British Medical Journal*, November 1869.)

Local remedies suffice in many cases for a cure; though in all local are greatly assisted by internal remedies.

The most potent external application is unguentum picis. The addition of a little creosote increases its efficacy. Nitrate-of-mercury ointment may be used when the patches are of small extent. Tepid, vapour, and sulphur baths are all occasionally of service.

TUBERCULATA.

Acne is generally described as an eruption of pimples or 'vari,' situated on the face, neck, or shoulders; very chronic in their course, and ending in resolution or imperfect suppuration. A more extended signification than this may, however, be given to it. Thus, it may imply simply an increased secretion of the sebaceous follicles, or their inflammation; or we may have superadded to the ordinary eruption, a varicose condition of the cutaneous capillaries with or without hypertrophy of the skin.

Acne commences at and after puberty, and rarely shows itself as a primary affection beyond middle age. It is one of the most frequent complaints incidental to the young adult, and equally common to either sex. Little difficulty is experienced in its recognition. The peculiarity of the eruption; the state of the skin itself, which from the activity of the sebaceous glands often has an unctuous or greasy aspect; the numerous black points at the extremities of the follicles; and lastly, its locality, render the diagnosis of acne in most cases an easy task.

The varieties of acne are the following:—acne simplex vel punctata, acne indurata, acne rosacea, acne sebacea, and acne syphilitica.

Acne simplex is distinguished by an eruption of pimples, varying in size from a pin's head to a pea, and scattered over the upper part of the body. In some cases it is limited to the face—the forehead, nose, and cheeks being mainly attacked; or it may at the same time appear on the sternum, or the shoulders, or between the scapulæ; and in the latter situation, by no means an infrequent one, its existence is often not detected by the patient. The pimples are hard, shining, and red. They arise in successive groups, and each pursues for the most part an independent course. Often they may be felt as little knots or tubercles embedded in the skin, while the larger and more prominent are observed in various stages of development. Among some of the earlier pimples after a few days, little yellow spots may be frequently seen at their summits, indicating matter beneath; but if this be let out, only a drop or two of pus escapes and the size of the pimple is scarcely diminished. It retains for a considerable time its hard circumference or base, and changing in some cases to a darker colour, as in acne indurata, slowly disappears. Many of the pimples do not suppurate at all, and in others the pustular stage is delayed for several weeks.

Interspersed in the eruption just described, and indeed noticeable in most of the varieties of acne, may be seen numerous black points or specks. These are the apertures of the sebaceous follicles, loaded with secretion, and rendered black from exposure to the air. Besides occupying some portion of the face, or shoulders, they may be frequently observed in the external ear, and as a rule are hardly raised above the level of the skin. Popularly denominated as 'grubs,' they can generally be dislodged by the aid of slight pressure applied to the margin of the speck, when a cylindrical mass is squeezed out, composed chiefly of sebaceous matter, besides containing in many instances, a minute parasite, the *acarus folliculorum.* The various stages of development of this creature are exhibited in Plate VII. in my work on diseases of the skin, from the ovum to complete maturity. It is not uncommon for two or more follicles to inflame and unite, and so produce a good-sized pustule; or the same may occur to a single follicle. These changes are often noticed in the course of the disease, even when advancing towards recovery; and should the complaint be severe, small blind boils will sometimes be found in adjacent portions of the skin.

In *acne indurata* all the above symptoms are aggravated, and the disease is moreover distinguished by an indurated state of the pimples, and their confluence in lines or furrows. It is usually declared at a later age than the preceding variety, and is most frequent between the twentieth and thirtieth year. In its progress it is remarkably slow, and oftentimes occasions great personal disfigurement, which is apt to be increased by the accession of furunculi. The latter are less prone to suppurate than in other kinds of acne, and are commonly oval in shape, and of a reddish colour; that these contain pus we have sufficient evidence by the thick and yellow secretion, which escapes when a puncture is made into the swelling. As recovery ensues, the apertures of the follicles long remain distinct enough to be plainly visible, while the pimples retain a livid or purple base.

Acne rosacea is more allied to erythema, and differs in many respects from the former varieties. When witnessed in early life or at puberty—not that it is commonly a disease of early life—it is sometimes severe, involving the greater part of the face, to which it is always confined. At this age, and particularly when occurring in the male, it will often prove to be hereditary. In the great majority of instances, acne rosacea is an affection of middle life, and in women is frequently worse just before the catamenia. The redness, from which its name is derived, is at first perceived only after meals, and limited to a small patch, usually seated on the nose or cheek; by degrees it becomes permanent. It is less observable in the morning, but assumes a brighter tint towards evening, and is increased by hot drinks, as tea or spirituous liquors, or by excitement or exposure, especially if the patient should afterwards enter a heated room, or approach the fire. Pimples, around the base of which the colour is always intensified, spring up, indolent in their nature, and tedious in attaining maturity; sometimes at the summit of these a yellow spot is seen, denoting suppuration beneath; or small blind boils become visible, particularly on the cheeks or chin. In many cases, and the more so as age advances, numerous dilated capillaries are seen in or just beneath the skin, tortuous on the cheek, where they are arborescent in their arrangement, while on the nose they are often longitudinal in direction. The complaint after a time loses its transitory character, and, peculiarly liable as it is to relapse, becomes confirmed. The skin no longer glides beneath the finger, but with the subcutaneous tissue becomes hard and thickened, and finally that hypertrophied condition is beheld which betrays the disease in its ultimate stage.

Acne rosacea is sometimes due to syphilis. It is then noticeable for the crimson flush, which commonly forms a continuous patch extending over the greater portion of the nose as well as the adjoining surface of the face. Developed upon it are small red tubercles, shining and semi-elastic to the touch; they are chiefly situated on the lower end or towards the side of the nose, and also on the cheek; when on the decline the redness vanishes, and although the tubercles may be scarcely recognised, their remains can still be plainly felt with the finger. The affected part is in no degree painful. It lacks the burning or smarting feel, which so often attends acne rosacea. In other cases syphilitic acne has no fixed seat of election. When the pimples around it suppurate, small brown scabs are formed, and a minute ulcer is left at the apex. After this has healed, a depressed and circular cicatrix is left, around which a darkened or copper coloured areola lingers for a long time. Another symptom indicative of syphilis is the absence of that oily secretion which is so general an accompaniment of acne.

Acne sebacea, although described in detail by most foreign authors, is sparingly alluded to by our own. I shall principally follow Hardy in his account of this affection, which, rare in this country, first attracted the notice of Biett. It is described as occurring in one of three forms—acne sébacée fluente, concrète, and cornée. In the first of these, the sebaceous matter is in a fluid state, and constitutes an unctuous covering on the surface of the skin. The secretion is unattended by pain or itching, and is often abundant. It occupies the same situation as the other varieties of acne, and is generally intermingled with them. In the second, the fluid concretes into a scab, varying in extent, sometimes occupying a large space, and in colour ranging from a light to the darkest hue. In consistence the scab is soft and easily moulded, and in recent cases removed with ease. Although similar in locality to the preceding, it sometimes appears on the scalp, and Rayer relates a case of acne sebacea of the scrotum. The last, or the acne sébacée cornée, is identical with the ordinary sebaceous tumours. (Hardy, *Maladies de la Peau*, folio 100; 1858.)

Various opinions have been expressed with regard to the causes of acne. The subjects of it, if young, are in otherwise good health. Unripe fruit, or great indulgence in beer or spirits, or insufficient diet will produce it; and in girls it is commonly associated with irregularity of the menses; venereal excesses may give rise to it, and there is little doubt that some of the worst instances of acne indurata are occasioned by masturbation. Acne rosacea is sometimes hereditary, and in those who are thus by nature predisposed, the disease is readily induced by any excess at the table, or even exposure to cold and wind; or it may be derived from artificial heat, as in cooks, smiths, and that numerous class who are constantly exposed to vicissitudes of temperature. The origin of the term 'rosacea' might almost seem to imply its limitation to those accustomed to deep potations of wine or other fermented drinks. But the complaint has no such exclusive restrictions, and even the most temperate are not exempt from it. In women, when the catamenia are about finally to cease, acne rosacea is apt to occur, as well as in both sexes, who suffer from hæmorrhoids or chronic disease of the liver. There is an eruption that I may refer to, which is sometimes produced by the bromide of potassium, taken internally and in large doses. Although it might be mistaken for acne, it more approaches impetigo sparsa, in its pustular character and occasional development on the scalp. It is a rare complaint, and one *sui generis*, as strictly speaking it exactly resembles no other form of cutaneous disease.

With respect to recovery, much will depend upon the duration of the complaint, and in no case should the patients be led to expect a rapid improvement. In acne indurata of a severe kind, a long period will sometimes elapse before any decided benefit is gained, and the same applies to acne simplex or punctata. Still, in any of these forms, as well as in acne rosacea, unless the latter possesses an hereditary tendency, a favourable issue may be anticipated.

In considering the different agents for the treatment of acne, we must be guided by its cause, continuance, and variety; and where there is sufficient reason to attribute it to any error in diet, or to amenorrhœa or other influences, the general state of the health should be regulated accordingly. The diet should be strict, and beer, or acid fruits, or salads especially avoided. If the long accustomed stimulus of alcohol has been suddenly withdrawn, it will be advisable to return to it in moderate quantity. The internal exhibition of steel and the addition of a purgative will commonly fulfil the requirements demanded by general treatment. Arsenic is seldom necessary in acne punctata or indurata, and not at any time in the other forms.

Local measures play no unimportant part in the treatment of acne; but care is required that they be not too stimulating. A lotion containing from two to four grains of the bichloride of mercury to eight ounces of rose-water, with the addition of half an ounce of rectified spirit, will prove useful; it is improved by the addition of half a drachm of dilute nitric acid. Sulphur is also serviceable in acne, and may be used in several ways; employed in a lotion it should be largely diluted. In other cases a lotion of bismuth answers extremely well in combination with mercury; one drachm of the trisnitrate, five grains of the bichloride, a drachm of spirit of camphor and eight ounces of water. Among ointments I may mention those composed of mercury or sulphur, which are to be lightly smeared over the parts once in twenty-four hours, and that at night before the patient retires to bed.

Before applying any of the above preparations, the patient should make use of a rough towel dipped in water as hot as can be borne, and thus by opening the pores of the skin cleanse the surface of any sebaceous matter that may have collected. In acne punctata he would also do well to rid the sebaceous follicles of their overcharged contents by making pressure at their sides with the finger nail, when a little cylindrical yellow mass will escape. Any small pimples already on the verge of suppuration should be opened with the point of a lancet, or if of larger size, touched with the acid nitrate of mercury. To remove or diminish the increased capillary secretion, when this exists in a marked degree, various means have been devised. Among the best is strong nitric acid, painted over the part with a fine glass brush, and then immediately absorbed by blotting paper. In the course of a few days the capillary vessels will be seen to be considerably diminished in number as well as in size. A repetition of the same acid may be employed to any spot that has not already showed signs of disappearing. When acne invades the chin, the latter is apt to become sore and painful. Neligan suggests in lieu of soap for those who shave, a saturated solution of the bicarbonate of soda, and an equal quantity of olive oil.—G. N.

Molluscum is characterised by round elevations, varying in size from a hemp-seed to a large currant or a hazel-nut, with a dark point and a depression on the summit of each. They have rather a translucent appearance; the colour of the skin over them is either normal or pinkish; occasionally there is a slight lobulation in them, visible through the skin. Some of the growths have no central depression and no black point. Some have a broad base (M. sessile), whilst others have a peduncle (M. pendulum). The skin over them is usually tense; it is occasionally wrinkled. These tumours either increase slowly in size, without any other change, or they ulcerate on the surface and their contents escape, or they inflame and slough *en masse*. They have been commonly believed to be sebaceous glands hypertrophied and altered. Some of them contain a white waxy or semi-fluid material, and a cyst which in some cases consists of several sacculi opening into a common cavity. Under the microscope are seen oil-globules and epidermal cells filled with granular matter. Others are more fibrous in structure. Dr. Beale* considers molluscum due to an alteration of the structures concerned in the formation of the hair, especially of the cells at the bottom of the follicle and the follicle itself, with hypertrophy of the subcutaneous areolar tissue.

Dr. G. Simon † describes two forms of the disease; one, which he calls molluscum simplex, he describes as due to an extra formation of connective tissue without any change in the hair-follicles or sebaceous glands; and the other, which he calls M. contagiosum, he regards as due to hypertrophy of the sebaceous glands.

It seems probable that there are two distinct diseases (both called molluscum) which present very similar naked-eye appearances, but are anatomically quite different.

Bateman, Cazenave, and others, used the term molluscum contagiosum; but most recent observers do not believe in the contagious character, and drop the epithet 'contagiosum.' M. Hardy states that he had not believed in the contagiousness of the disease till within the last few years, during which he has seen instances of what seemed to be evidence that it could be thus propagated. He thinks that this property is to be explained by the presence of branched tubes containing the spores of a cryptogamic plant, which he believes are constantly to be found in the tumours of molluscum. Professor Hebra, on the other hand, has tried to propagate the disease by rubbing the contents of the tumours on different parts of the skin without any result. The usual seats of molluscum are the trunk (either back or front), the neck, face, and scrotum. It is not attended with any constitutional disturbance. It may exist at any age, but is most commonly met with in children.

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* *Path. Soc. Trans.* vol. vi. p. 313.

† *Die Hautkrankheiten*, &c., Berlin, 1851, pp. 235, 354.

Treatment.—This is purely local. The tumours may be laid open, and the interior rubbed with lunar caustic. If attached by a pedicle, they should be snipped off and the base cauterised.

T. H.

Lupus.—The chief characteristic of lupus is to be found in its devastating agency. Wherever situated, the skin is there destroyed, and finally replaced by a permanent cicatrix. It is, however, by no means limited in its ravages to the skin; sometimes it occasions an utter obliteration of the features; in other cases, it ends in a loss of cartilage; and in more rare instances of bone. Generally of tubercular origin, it may be succeeded by ulceration of a most active or else of a most indolent kind; or again, no ulceration whatever may be observed throughout. Never contagious, and most seldom hereditary; situated commonly on the face; disposed to bleed from slight causes, and almost always aggravated by exposure; lupus, from its diversity, is not easily described in exact terms. Lupus may be said to admit of the following divisions:—Tubercular lupus, strumous lupus, exedent lupus, syphilitic lupus, impetiginous lupus, and erythematous lupus.

Tubercular lupus is strictly a disease commencing in early life, for the most part appearing between the ages of two years and seven, and seldom primarily developed beyond the period of puberty. The affection is usually represented by a number of distinct tubercles, forming an isolated patch, and disposed on some part of the face, as the cheek or nose. The tubercles are of a reddish hue, slightly flattened at their summits, and in size ranging from a rape-seed to a split pea. Their colour is modified by circumstances, and although at times pale, it is generally heightened by such agents as mental excitement or the warmth of a heated room. Beginning as a tubercle, frequently not larger than a pin's head, the complaint may remain stationary for months, ere it exhibits any signs of increase. At length enlarging at its circumference, it presents an irregularly flattened surface, slightly elastic to the touch, of a dull or imperfectly red colour; and bounded by a well-defined margin, which in the direction of its growth is studded with smaller and similar deposits. Sometimes crusts, not unlike those of eczema, may be observed upon it, which if forcibly removed are followed by bleeding, and even by ulceration, or the same result may happen from a blow; but if undisturbed, ulceration does not occur. In other instances, scales rather than crusts are formed of the thinness of tissue paper, adherent in their centre, and curled and white at their edges. Under treatment the tubercles disappear by interstitial absorption rather than by ulceration, and leave in their room small white and indelible cicatrices. Sometimes the patch, level and of a whitish hue in the middle, shows at its border a number of irregular tubercles; or its whole surface is preternaturally smooth, mottled, and dotted with tortuous capillaries. Seldom at any time of its career is tubercular lupus attended by pain. It is a source rather of discomfort than distress to the patient, whose health continues unaffected. Associated in a slight majority of cases with struma, as proved on inquiry into the history, although not often evincing any of its external signs, tubercular lupus exhibits a slowness in its progress unequalled by any other variety; and it is not infrequent to find the disease, originating as just described, after the lapse of twenty years and more, not exceeding in diameter that of a crown piece.

Commencing like a small boil, *strumous lupus* is distinguished by its tendency to pass into a state of superficial ulceration, unaccompanied mostly by pain. The sore thus established does not readily close. Sometimes it is all but healed when ulceration breaks out afresh, and the same process is repeated again. It is not so destructive as the exedent variety, and pursues its serpiginous course with slight progress for years. When a part has healed for a considerable time, the central portion will in many cases be smooth and dull white, firm, and quite devoid of all natural resiliency. In other cases, the greater part of the surface appears more or less glazed, with a few thin yellow crusts upon it, concealing a number of small and superficial ulcers ; or the disease, soon after its origin, may lie dormant for a long interval, and then give rise to a circumscribed sore covered with a scab. Such is the varied course which strumous lupus may assume. When seated on the cheek, which it is in most cases, eversion of the lower lid sometimes takes place from the contraction of the cicatrices, and exposes the mucous membrane of the conjunctiva ; and hence a constant overflow of its secretion, to the annoyance of the patient ; or beginning on one cheek, the complaint may pass ribbon-like beneath the lower jaw to a similar spot on the other side. Another situation not very uncommon for strumous lupus is the back of the hand or the forefinger ; and it is more usual on the upper than the lower extremity.

The *exedent* is the most frequent variety of lupus. Taking rise as a small hard tubercle, it merges after a variable period into the suppurative stage, and becomes then covered with a scab. The disease may be circumscribed and limited to a single spot. More commonly other tubercles appear in the immediate vicinity, which pass through a similar stage to the first. When situated on the nose, for which *lupus exedens* seems to have a special predilection, a number of crusts may generally be seen to involve its lower part, adherent and of a greenish-yellow tinge. Should they be removed, a thin light yellow fluid may cover an excavated ulcer : or in place of any secretion, a red granular surface only is left, which bleeds on the least pressure. So soft indeed is the part, that several of the granulations are often entangled between the blades of the forceps employed to detach the scab. Lupus exedens sometimes attacks the nose from within ; its mucous membrane first becomes increased in vascularity as well as swollen at a certain spot, and a small crust is established, which in most cases is picked off by the patient. Ulceration still goes on beneath a new crust, and at length perforation takes place, should the septum be the seat. Lupus exedens may exist in other parts at the same time, as on the neck, or little toe, or on one of the fingers, proceeding in its course to the complete destruction of the latter ; or it may spread over the whole face and scalp. Sometimes no pain of any kind is experienced ; occasionally a sense of itching is felt, worse towards night and generally after meals, or only after certain articles of food have been taken. The disease is almost invariably increased by exposure to cold and wind, and often aggravated at the catamenial period. The consequences of lupus exedens vary with its situation and the stage at which it has yielded to remedies. Thus, if treated at an early period, as when on the nose, no visible alteration may remain beyond a slightly indented scar; or in a stage removed from this, the end of the nose may be pointed and irregular; or should the cartilage be destroyed, a smooth and polished appearance is given to that portion which remains. On the cheek, the resulting scar if small in its outline is sometimes of a colour inclining to purple; but when more extensive or in other parts, the cicatrices constitute white and thickened bands similar to those produced by a burn. When the disease encircles the mouth or one or both of the nasal apertures, they sometimes become contracted as cicatrization ensues. Lupus exedens may occur on the upper lip immediately below the septum of the nose, the cartilage of which, as well as the lateral cartilages themselves, soon become involved in one common destruction.

Syphilitic lupus is sometimes manifested by the effects of constitutional syphilis being superadded to the ordinary signs of lupus, particularly of the strumous and exedent varieties. Seldom can any reliable conclusions be drawn from the patient's history. Its situation and its multiplicity should be taken into account. Thus it may attack the forehead or the bridge of the nose, and invade at the same time a great part of the upper extremity. I have seen it occasionally attack the buttocks: a serpiginous or horseshoe form is very characteristic of a syphilitic taint. Sometimes we observe one or several patches on various parts of the body, having a smooth centre but a raised and rugged margin, partially covered with crusts and much inclined to bleed. These patches are not uncommon on the forearm near the wrist; a case in a child of about eight years of age was under my care at the Hospital, in which the complaint was situated on the calf of the leg. In another and opposite kind, but not the less syphilitic, the disease destroyed the lower part of the nose in a young woman, and the margins were surrounded with dense and quickly-growing tubercles. It is not necessary that the complaint be severe in order to be syphilitic, but it may nevertheless owe its severity to such constitutional taint. The worst case of the kind which has occurred to me was that of a boy aged thirteen years, an out-patient of the Hospital, who had been suffering from this complaint ever since he was three years old. The nose became quite destroyed, and the mouth reduced to an aperture scarcely large enough to admit the finger. None but those about him could understand his altered articulation. The teeth were nearly all destroyed, and at a subsequent period he lost his left eye.

Impetiginous or papulo-pustular lupus is a name applied by Mr. Startin to that species of lupus the external characters of which resemble those of impetigo. The disease mostly occupies a considerable portion of the face, either as one large and irregular patch or else subdivided into smaller groups. In any case the suppuration is abundant, and the crusts are yellow, and easily separated. The latter are neither curled at their circumference, like those of eczema, nor yet raised, as in porrigo; and if removed are quickly renewed. When the scabs or crusts are circumscribed, the surrounding skin is often inflamed, but it still retains its natural elasticity. Impetiginous lupus is often engrafted upon struma.

Among the more immediate causes of lupus, the receipt of some local injury is often assigned by the patient as the occasion of its first appearance, and hence its origin is frequently attributed to a blow or scratch. Sometimes it is reported to have succeeded a severe fright, or other strong mental emotion.

In the local treatment of lupus exedens, when the part is covered as it usually is with a firmly adherent scab, the latter should be removed. In slight cases this is accomplished with a pair of ordinary dressing-forceps; but in the more severe, the scabs or crusts should be previously moistened with rags dipped in hot water, or with a poultice. To the surface now exposed we apply for a few seconds a little cotton or carded wool, to soak up any pus or blood; and as soon as it is thus cleansed, the part should be touched with the solid nitrate of silver, cut, if requisite, to a point; or else painted by means of a glass brush with the acid nitrate of mercury. Sometimes it is expedient to conceal the immediate effect produced by the acid, which is easily done by covering the surface with a piece of red blotting paper, and then painting the latter with collodion. No interference is to be allowed with the eschar occasioned by the caustic. After it has come away, the surface should be wetted two or three times a day with a weak nitric acid lotion; if it still looks unhealthy, a second application of the acid nitrate of mercury will be required, and may be repeated at intervals of two or three weeks. In other cases, in which, as recovery ensues, a red and granulating surface is left, we may substitute with advantage carbolic acid in the form of a lotion, and this should be applied over the thin scales which have replaced the former scabs. In lupus exedens, and particularly if it be conjoined with struma, cod liver oil will prove a valuable remedy. In what manner it is assisted by mercury is not so clear, but given in combination with this mineral, as half a grain of calomel with opium every alternate night, or three times a week, its efficiency is much increased.

In tubercular lupus, the tubercles should, as in the exedent variety, be touched at their summits with a similar caustic. It matters little which is employed, the acid nitrate of mercury, or nitric acid, or caustic potash; but each should always be of the strongest kind, and never applied over too extensive a surface at one time. Tubercular lupus, as far as I have observed, admits of no other local treatment. The caustic requires to be repeated at intervals, until the tubercles are nearly reduced to the level of the skin; for if allowed to extend deeper, little excavations or pits remain, which should be avoided. The patient should be cautioned that considerable inflammation is apt to follow the use of the caustic agent, whatever it may be, and that three or four days or more will often elapse before it abates. As regards constitutional treatment, cod liver oil and mercury may be given, as in the other forms.

Although by these means we shall succeed in reducing the tubercular mass to the lowest point of which it is capable, and sometimes to such a degree as to render what was before an unsightly object now scarcely perceptible, it should be remembered that the tubercles are very likely to form again, and this tendency must be accordingly corrected. In no kind of lupus is the tendency to recur more frequently shown than in the tubercular variety.

In strumous and in the papulo-pustular lupus, when the suppuration is free, and the ulceration superficial, an arsenic and calomel caustic* will be most useful. Sometimes in children this is too stimulating, and calomel alone is the better application. These cases are seldom able to bear the more severe caustics; they are more likely to improve, as well as the syphilitic lupus, should the ulcerated surface be extensive, by the application of a weak nitric acid lotion and the trisnitrate of bismuth.

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* It is made thus:—acidi arseniosi, gr. iij.; hydrargyri bisulphureti, gr. ij.; hydrargyri chloridi, ʒj. The powder is made into a paste with water, and applied with a camel-hair brush after the scab is removed.

Plastic operations for the restoration of the nose from lupus have been performed within the last few years by Mr. Hamilton of Dublin. Time, however, furnishes the only safe ground on which to base our conclusions as to their success. Tried by this test the final issue, even in selected instances, has not been such as to lead me to anticipate a hopeful result from operative interference. In all cases of this kind we have diseased tissue to deal with, and hence sloughing of the part is a likely contingency—an event which mars the best operation; for unless union takes place by the first intention, the condition of the patient is rendered worse than before. Again, there is often great difficulty in forming a proper septum, which, should the disease return, is almost sure to be destroyed. But the strongest objection is to be found in the fact that the new structure has finally dwindled or degenerated, after apparent success has at first been gained.

Sometimes we are called upon to repair the ravages produced by destruction of tissue in the lips, over which the saliva is always dribbling. In such a case our first endeavours should be directed to promote cicatrization, an obstacle to which is often to be found in an offending tooth. A well-marked case of this character was that of a man advanced in years, and who had long been an out-patient under Mr. Startin. After the surface had healed, an attempt was made to supply the deficiency of the lower lip, which was almost wholly destroyed, by an artificial one formed of gutta percha and afterwards stained of the natural colour of the skin. This was attached by either end to an elastic band, which passed round the back of the head and served to keep it in position. By the aid of this simple contrivance the patient could partake of his food with comparative comfort. He was also able to resume his work as a gardener, without being subjected to those personal annoyances which his former disfigurement frequently gave rise to.

The subject of *erythematous lupus* has received so little attention from writers on diseases of the skin, that I shall offer no apology for dwelling at greater length than usual on this not uncommon variety. The duality of name, I may remark, by which it is distinguished, sufficiently expresses its twofold character, and will be found of very general application.

Besides the proper symptoms, which will be presently described, erythematous lupus has the following history. It is not a complaint of childhood, and most rare before puberty; in so far as age is concerned, it pertains rather to middle life. The influence of sex is remarkable, and the frequency of its occurrence in the female in comparison with the male may not be unduly represented at eight or ten to one. Unlike other kinds of lupus, the erythematous is met in the higher equally as in the humbler ranks of society; occupation, indeed, would seem to have little power in its primary manifestation, however it may affect the issue, as in those callings which demand continued exposure, whether to extreme heat or cold. Again, erythematous lupus is commonly associated with good health, and as an affection of the skin it occurs alone, being seldom attended or followed by any other cutaneous complaint. Lastly, the disease is in no degree hereditary, nor, I may add, contagious.

The earliest sign of the eruption is in general denoted by an erythematous patch on the face, usually the cheek, but it may be the nose or forehead, which, at first only temporary, becomes afterwards permanent. When the patient has what is called a high colour, the preliminary redness is sometimes scarcely noticed, while in an opposite class its occurrence is at once observed; in many instances, before assuming a persistent character, it appears only at a particular time, as, for example, in the summer months, and again returns during a like period for two or more consecutive seasons. There are now developed, on or near the centre of the patch, small white scales, which increase in number until they approach its edge, where a clearly defined border is left. The scales occur in two forms, either as scurf or as a crust, but in either case they closely adhere to the surface. The first of these is the most frequent, and as a rule accompanied by a sense of heat and itching in the part, particularly if the patient be exposed to a cold wind or the warmth of a fire. The complaint thus established, terminates either in a white cicatrix, which as a rule is on a level throughout with the surrounding skin, destitute of scales, and devoid of any hardness; or it may end in complete recovery, and exhibit no trace of its former existence. In the second class the crust, as it may be truly styled from its increased thickness, is not detached without difficulty from the skin, and when removed, there are seen on its under or attached surface a number of minute projections which dip into the follicles of the cutis, and render more intimate the connection between the two. A further stage consists in the following curious condition, which the part thus affected undergoes. The crust has disappeared, and a peculiar mottling of the skin is left, which may be likened to the dotted surface of the cut rind of an orange or lemon. The period when this takes place varies in different cases: it may commence within a few weeks of the outbreak of the complaint, or it may be deferred to a much later date. Let it happen when it may, this condition implies a structural change in the skin, which, in my experience, does not admit of a return to its normal state; it approximates to a cicatrix, and to this it at length tends, becoming with age smooth and white but still elastic.

Although the above may be instanced as the usual types of erythematous lupus, departures from them nevertheless will happen. In some, the crust of which I have just spoken occurs by itself, with no erythematous base, and in this case the part attacked occupies but a limited space. In another class, the scales are so numerous and extensive as to well nigh conceal the patch on which they rest, and give to the complaint an appearance much resembling psoriasis. In a third kind, the disease is seen in a multiple form, and approaches more nearly to erythema with a sparing quantity of scales on its surface.

Besides the localities already named, the disease is sometimes declared on the eyebrows or the lids, and these may even furnish the only evidence of its existence. In the former it is for the most part speedily followed by a loss of hair on the patch, which is seldom if ever renewed; and in the latter it generally manifests itself as separate and circular spots, or it may attack either canthus, and thus involve both lids simultaneously. Sometimes along the line of the eyelashes, where the complaint encroaches on this part, a row of small scales will be seen to surround their roots; and in chronic cases, the mucous lining of the affected lid exhibits in one or more places a deeply red spot, while the rest of the same surface shows a brighter hue than natural, or by comparison with that of the other eye. As a sequence, an excess of the lachrymal secretion takes place, which is often the means of directing our attention to the condition of the lid, and so detecting the appearance it assumes. Should the complaint affect the ears, the lobes are commonly the first to suffer; from these it may creep along the whole rim, which in confirmed and chronic instances shows a singular departure from the state of health in the white, rough, and wrinkled, almost sodden appearance it presents. In others, the disease is mainly confined to the back of one or other of these organs, or the front of the concha, from whence it may travel along the external auditory canal, and interfere with the sense of hearing. Equally in common with the above regions is erythematous lupus prone to attack the scalp, particularly in or near the middle line, where one or more patches may be observed destitute, as on the brow, of hair; and if of long continuance, assuming a smooth and perfectly white aspect. Again, the exposed mucous surface of the lips offers another and not at all an infrequent locality; the complaint in this situation being conspicuous for the dry state of the membrane, which is rough from the presence of small and semi-adherent scales; or it may involve the mucous lining of the nostrils, commencing, as is usually the case, on the skin near the septum, and gradually spreading upwards, causing both annoyance and discomfort to the patient.

Such are the regions which singly or in succession may be invaded by erythematous lupus, although developed primarily, as it is wont, on the cheek or nose. They may even constitute, but this is rare, its original site, and the latter become in consequence secondarily affected. In respect of frequency, no special liability can be said to apply to any of them. In one case it is the nose and ears which alone suffer; in another, the cheeks and scalp and so on, until every possible combination is produced. Whatever its situation, the tendency of the disease is to spread, and this may take place in two ways, either by an extension of the patch at its periphery, or by the evolution of separate spots, mostly circular in form, in various places on the surface. As illustrating its general course, I would remark that where the cheek, for example, is the subject of this complaint, it mostly happens that sooner or later a similar patch arises on the other side, and these enlarging at their circumference approach one another, and spanning like an arch the bridge of the nose ultimately coalesce, forming a sort of mask which envelopes the greater portion of the face. In extreme cases, in which erythematous lupus has existed for many years, we may sometimes note at one and the same time the various phases of development and decline. Not always, however, as if to demonstrate its uncertainty, is erythematous lupus thus progressive. Sometimes the complaint is confined to a solitary spot or patch, which for years makes little appreciable advance.

Although from the chronic nature of the complaint we cannot in severe examples predicate the time when its progress will be stayed, or question the possibility of a relapse in other cases of recovery, the disease, whatever its form, is largely determined in its course by the following events. In the first list may be ranked anything that depresses the mind, whether care, anxiety or grief. In like manner exposure to a cold wind is sure to aggravate the disease, and so will in many cases a too near approach to the heat of a furnace or a fire, or a protracted stay near the sea-coast; not seldom is erythematous lupus associated with leucorrhœa, or some uterine disturbance or ascarides or hæmorrhoids. Even a slight derangement of the general health or habitual costiveness or too much indulgence at the table will occasion a similar result. Some of the worst cases of this affection that have passed under my notice have occurred in those who have been obliged to work daily in the fields, besides subsisting on scanty fare. In these the chance of permanent improvement is slight as long as the above influences exist. In other cases, and particularly when the affection is seen in an early stage, a more fortunate issue may be anticipated. At the present time I have a case at the Hospital for Diseases of the Skin in which scarcely a trace remains, only a minute spot is seen near the outer angle of one eye, and one or two small spots on the eyelid; in this the patient has entirely recovered from the disease, which for seven years occupied the greater part of the cheeks and nose. I have already alluded to a multiple form of erythematous lupus occurring on the face, and in this variety the prognosis is favourable.

Diagnosis.—Unlike most eruptions of the skin, it is in its early stage that the difficulty of diagnosis is usually greatest, although in many cases its true character has not been suspected at any time. Nor will this be altogether a matter of surprise, when the comparative rarity of the complaint is considered, or its varying aspect in the same patient, and still more in different instances. In the majority of its symptoms, the erythematous is wholly distinct from the other kinds of lupus, and at no period is it attended by that destruction of the soft tissues or of cartilage which gives to lupus in general its hideous significance: indeed, so entirely exceptional is the supervention of any deep or depressed scar, that in one example only have I observed this result. It was that of a lady of middle age, who had three or four such cicatrices on different portions of her face, each in diameter of an average size of a split pea. From its restriction to the skin, and the occurrence of scales on the patches, erythematous lupus may be mistaken for psoriasis; for so abundant is the squamous covering in some cases, that an error on this point may be well imagined. On examination we shall discover that the scales are not accumulated towards the centre, that the progress of the patch, if a solitary one, is in general slow, and the redness remarkable for the abruptness of its margin. The scales are moreover so adherent, that friction fails to remove them. Among other aids to diagnosis may be added the development of the disease at or after puberty, and its limitation, except in a few instances, to some part of the face or scalp, the latter remarkable, as alone ever affected by this form of lupus. Again, there are certain species of secondary syphilis, which bear a close similitude to erythematous lupus; and the more so if confined to a single patch, situated it may be on the side of the nose, forehead, or cheek.

As an illustration, I may briefly mention a case which I recently saw, of a gentleman, aged thirty years, who had a patch of erythematous lupus near the temple; it was partially concealed by the whiskers, and was moreover crescentic in shape, measuring four inches from end to end. It caused no inconvenience, and had existed for one year. A close investigation showed its real nature, which was confirmed by the existence of a small similar spot on the lobe of the ear.

In the variety characterised by the peculiar mottling of the skin to which I have before adverted, a mistake in diagnosis is less likely to arise, and in all instances the co-existence of a similar complaint in such regions as the ears, scalp, or mucous membrane of the lips will be strongly corroborative of the diagnosis of erythematous lupus. Finally I may add that when occurring only upon the cutaneous surface of the lids, or around the eye, it is frequently confounded with eczema; or if at the eyelashes, or the adjacent conjunctival lining, with tinea tarsi.

Treatment of erythematous lupus.—The use of the more powerful caustics is inadmissible in this form of lupus. Should the complaint have made little progress and present a good deal of redness the patient may apply twice a day with advantage a weak solution of nitric acid. The benefit of this treatment is most apparent when much cuticular desquamation overspreads the patch; or if smarting pain be felt in the evening, a lotion of borax, a drachm to eight ounces of water, with two drachms of dilute hydrocyanic acid, may be substituted. If the disease be very limited and as yet in an early stage, I have frequently found that blistering the part in the first instance is useful before having recourse to either of the above lotions. In some cases, as when the scales are unusually thick and removed with great difficulty, the arsenical powder applied over them has succeeded in rendering the surface smooth but still red. Internally steel is recommended, to which in chronic cases arsenic may be added.

Cases are related of lupus ending in spontaneous recovery. This is contrary to all I have ever seen of the disease, which, left to itself, instead of inclining towards improvement, is distinguished by an opposite tendency. It may happen that for a while this affection may remain stationary, as in the tubercular form, but it is contrary to experience that the tubercles should of their own accord disappear; indeed, I would rather say, that the degree of relief to be expected or attained in lupus is proportioned to the period at which the remedy is applied, and not to any inherent property the disease possesses to become exhausted or to wither away. The plan which is sometimes recommended, of treating the disease by constitutional measures alone, as cod liver oil, and at others by local means only, can scarcely apply to a complaint which differs so much in its symptoms, progress, and issue, and whose course itself is so liable to vary. G. N.

Elephantiasis Græcorum, or *tubercular leprosy*, or *leprosy.*—Without entering into any argument as to the identity of this disease with that so frequently mentioned in Holy Writ, or described from the earliest dawn of profane history as existing in Egypt, there can be no doubt that if we refer to the records of the 14th and 15th centuries of our own era, we shall find abundant evidence of its ravages over the greater part of the continent of Europe, and that the inhabitants of these islands were in no way exempt from it. Happily rare among us at the present time, the complaint nevertheless prevails to a great degree in Norway, Denmark, and Greece. In the East and West Indies, the Azores and Madeira Islands, and along the shores of the

Mediterranean, it is not at all uncommon. For an interesting addition to our knowledge of leprosy we are indebted to a professional visit paid by Dr. Webster to the Hospital for Lepers at Granada, founded by Isabella, and supported to this day by the Spanish Government. The results of his inquiries are embodied in a paper which was read before the Medico-Chirurgical Society in 1854, and to the facts therein contained I shall have occasion to allude.

Leprosy is much more common in the male than the female. Of 284 lepers who were reported in Spain in 1851, 188 were of the former and 96 of the latter sex; and at the period of Dr. Webster's visit the ratio between the sexes was thirty-five to fourteen. The experience of Mr. Day confirms this statement as regards the greater prevalence of this affection in the male among the natives of Madras. In Bombay, at the Jamsetjee Jeejeebhoy Hospital, where all classes of natives are admitted, the proportion is still higher than the preceding. At the seat of this latter Presidency the disease is well known among the natives; it is not restricted to caste, but affects the Anglo-Indian, Portuguese, Parsee, Jew, Mussulman, and Hindoo. Although comprising two divisions, the tubercular and the anæsthetic, it must be understood that these are frequently united in the same person, and that the latter is often found to merge into the former variety of the disease.

The following table shows the percentage of ages as given by Mr. Day:*—

Below 10 years	4 per cent.
From 10 years to 20 years	6 „
„ 20 „ 30 „	22 „
„ 30 „ 40 „	22 „
„ 40 „ 50 „	32 „
„ 50 „ 60 „	2 „
„ 60 „ 70 „	10 „
Above 70 „	2 „
	100

Elephantiasis is comparatively rare under puberty. Its effect in shortening life is variously stated by different authorities. Although it may show itself at any age, yet when it happens in the young subject or before puberty, the general signs indicative of the latter are deferred beyond the usual time; the hair becomes scanty and ill-formed, and the whole frame ill-developed.

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* *Madras Quarterly Journal of Medical Science,* 1860, p. 289.

Moreover, when it appears at this period of life the patient seldom survives beyond a few years.

Anæsthetic leprosy occurs in patches, and is characterised by a want of sensibility in certain parts of the skin. The patches are small, circular, and serpiginous; sometimes little elevated above the surface, and in size ranging from a threepenny to a crown piece. In colour they may be almost white or reddish, and at the margin of a light brown. They are found on any portion of the trunk or the extremities; or on the face, as the forehead, cheeks, or lobes of the ears. Sometimes the patches coalesce, in which case a large extent of surface is occupied by the discoloration. It is in their centre that anæsthesia is most marked: not that this sign is confined to the patches; it may extend along the greater part of the trunk or limbs, following the course of one or more of the nerves. The diseased surface is generally dry and wrinkled, mostly destitute of hair, and devoid of moisture. Sometimes the skin of the fingers or toes is shrivelled and covered with exfoliation of the cuticle. In a few instances a pricking pain is first felt, and in some an eruption of vesicles or bullæ is among the earliest symptoms. These soon burst and form ill-conditioned ulcers, which are slow to heal, and secrete an offensive sanies. After the discharge is reduced, the ulcer, although not extending at its circumference, increases in depth, reaching to or exposing the bones. The phalanges of the fingers or toes are in this way attacked, and become attenuated in their centre. Supposing one of the hands to be affected, the patient loses power over the extensor muscles, the hand drops, and he is unable to straighten it. Although it may extend to the trunk, anæsthetic leprosy does not often commence in this region. It generally proves fatal through the supervention of some exhausting disease, as dysentery or diarrhœa.

Tubercular leprosy is preceded by a variety of symptoms. Sometimes the first thing that attracts the notice of the patient is a numbing pain in the part, or there may be only œdema. More commonly irregular patches are observed, slightly elevated, and of a grey or brownish colour. On these patches are developed small tubercles, which are usually of a red hue. With their multiplication and increase on the face the countenance becomes greatly disfigured. They are often collected near the apertures of the nostrils; or on the upper lip; or on the forehead, which is thrown into large folds; or they may commence on the lobes of the ears. The occurrence of a febrile paroxysm is noticed by some authors, during which the local symptoms are aggravated. With its disappearance, and it generally lasts about three days, the patient feels little uneasiness, and sometimes the blotches disappear. This condition, however, is only temporary, as sooner or later they return. After a time other complications arise, which involve one or more of the organs of sense. The tongue or the soft palate is covered with similar tubercles, which, as they ulcerate, produce a fœtid discharge. As the tongue participates, all appreciation of taste is lost, deglutition is with difficulty performed, and the voice has a harsh sound, or is scarcely audible. If the disease spreads to the vocal cords, or the trachea, the patient dies from suffocation. When the nose is implicated, fragments of diseased bone are often intermingled with the pus. Sometimes ophthalmia is induced, which is generally the forerunner to further and destructive changes taking place in the eye.

A difference of opinion exists as to the influence of leprosy on the generative organs. Most modern authors reject the testimony of antiquity on this point, and regard as fabulous the *libido inexplicabilis* recorded by older writers. Dr. Webster confirms the judgment of the latter, relying on the statement of Dr. Alveiro, who for many years filled the post of Superintendent of the Leper Hospital. Whatever may be the effect at an early stage, there is reason to believe that with the progress of the disease atrophy of the testes is far from being an infrequent result.

As to the causes of leprosy, little is known that can be urged with certainty. In the fertile districts around Granada, which teem with an agricultural population, provided with the ordinary requirements of life, the complaint is rare; indeed, it is mostly limited to the sea-coast. The same may be said of its appearance in France, where it is chiefly seen in the southern provinces of the empire. It is uninfluenced by occupation. Although no age is quite exempt, it is very infrequent as a primary affection under the age of seven years, nor does it often occur after the middle period of life. However free from it the pure English race may be in India, it will attack those of mixed descent in that country and in the West Indies. I am credibly informed that it is not uncommon in the white population who have long resided in the latter colony. In India it is chiefly confined to the poorer classes of the community, but the rich do not always escape. A diet consisting mostly of fish is supposed to be favourable to its development; the disease is nevertheless frequently met with inland, as in the Deccan and the North-West Provinces.

With respect to hereditary transmission, there is no doubt that elephantiasis is sometimes received in this way, more often than the subjects of it are able or willing to admit. Leaving their homes at an early age, many of the natives are but imperfectly acquainted with the history of their own families, and other obvious reasons forbid any positive inquiry. As in other hereditary complaints, elephantiasis will occasionally pass over one generation to reappear in the next. It is never contagious. It is not known to extend to those whose duty it is to wait on the sick, or who are otherwise brought into personal contact with them. A leper may continue to live with his family for years, without at all communicating the disease to any of them; nor is he considered an outcast so long as he can toil for his bread, or has the means of supporting himself. It is when his resources at length fail, and he is obliged to beg in the bazaars, maimed and mutilated, that he becomes an outcast in reality, and presents a picture of misery, to which it would be difficult to furnish a precise parallel.

Much of the obscurity that long enveloped the morbid anatomy of leprosy has been dispelled by the valuable investigations of Dr. Carter,* who, as surgeon to and curator of the Museum of the Jamsetjee Jeejeebhoy Hospital, had ample opportunities of pursuing his inquiries. The conclusions he has arrived at, and which are published at full length, throw an entirely new light on this important point. It is in the altered conditions of the nerves that we must really look for the seat of mischief. To the eye the affected nerve is considerably enlarged, and changed in colour to a reddish grey. On section its funiculi are remarkably firm, but the neurilemma is unaltered. Microscopical examination shows the nerve tubules at the seat of the enlargement to be more or less wasted and atrophied, and accompanied by fatty degeneration. The places at which these characters are seen vary with the nature of the nerve. Another result of the same disease may be mentioned in reference to the bones, as the digits, which after a time undergo remarkable changes, due to interstitial absorption and necrosis. The fingers and toes are sometimes reduced to so many stumps, and in every case the last phalanx is the first to suffer. The bones themselves become likewise lighter and thinner.

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* *Transactions of the Medical and Physical Society of Bombay*, vol. viii., new series, p. 1.

Little can be done in the way of treatment. In an early stage, before the tubercles have ulcerated, the complaint is in some cases arrested for a time by the internal administration of mercury, given in a decoction of bark, or some other kind of tonic. The prognosis, however, in any case, is very unfavourable.

Elephantiasis Arabum, sometimes styled Cochin, or Barbadoes leg, is that species of elephantiasis which has its seat in the extremities or the genital organs. Unlike elephantiasis Græcorum, it has never been a conspicuous disease in Europe. Although its derivation would seem to imply an Arab origin, the complaint is less frequent at the present day in Arabia than in certain parts of India, as the lower provinces of Bengal, and particularly along the coast of Malabar.

Elephantiasis does not affect the extremities in the same degree. The lower limb is generally selected, the swelling commencing at the toes, or some other part of the foot, or the ankles. Extending upwards from this point it is arrested by the annular ligament, which for a time checks its further advance. The increase of the leg nevertheless proceeds, and in many cases stops short at the knee. The swollen limb is hard and brawny to the touch, and little capable of impression: it is often covered with thick cuticular exfoliations, resembling ichthyosis, and which decrease in number and size from below upwards. In this state it may remain for years, causing little pain, and inconvenient only from its bulk.

The further progress of the complaint is frequently proportioned to the fatigue that the patient has to encounter. As long as the limb is allowed to remain quiet and horizontal in position the increase is inconsiderable, but continued exertion, as standing, aggravates the local symptoms, and the pain, at first intermittent, becomes constant and unceasing. The limb is greatly enlarged, and also the superficial veins. It is hard, and of a reddish tinge. Should the disease continue to advance, the pain is increased, and ulceration commences at the toes, which are successively destroyed, or large ulcers form on the other parts of the foot. Unhealthy granulations occur on the toes, thus reduced to stumps, and show little tendency to cicatrize. In some cases, when the thigh becomes involved, the varicose veins burst, with marked relief for a time to the patient. The pathological changes are not always the same; sometimes, and perhaps this applies to the majority, the skin only is affected; it is simply hypertrophied. In other cases the greater part of the enlargement is due to an increase of the subcutaneous tissue, an example of which lately came under my observation.

A woman beyond middle age, and imbecile, was admitted, in July 1865, into St. George's Hospital, under the care of Mr. Pollock, with elephantiasis Arabum of both legs, but most severe in the right. The limb was amputated at the knee joint, and the following notes I made immediately after its removal:—

The greatest width is at the instep, which measures fifteen inches in circumference. The sole of the foot is scarcely changed, neither is the calf of the leg at its upper part, as it approaches the knee. The skin over the metatarsus is ulcerated to the depth of the subcutaneous tissue, and shows a finely granular and almost smooth surface; in either direction, in extent it equals three and a half inches. In like manner destroyed is the skin of the first phalanx, each of the great and fourth toes, the fifth is intact, but the second and third have entirely disappeared, only two short projections remaining, which are partially covered with granulation; the posterior margin of the ulcer is thick, tuberculated, and slightly undermined. On the inner side and front of the leg, at a distance of two inches above the internal malleolus, is another ulcer of similar size to the preceding, and bounded also by a thick and hardened border. The whole skin, from the toes upwards to the calf, is greatly hypertrophied, and unyielding to the touch. Developed on the front and back of the limb are some round tubercles, arising from the cutis itself; while more thickly grouped are masses of cuticle, which are easily separable, and on detachment leave a whitish surface exposed. The tubercles are few in number, and not much larger than a pea; they are not so readily removed, and any attempt to dislodge them is attended by an oozing of blood. On cutting through the skin by a longitudinal incision from the upper part of the leg to the sole, it is hypertrophied to about twice its normal thickness, but the enlargement itself is chiefly produced by a great mass of subcutaneous tissue.

So prevalent is elephantiasis Arabum in British Cochin, that Mr. Day,* who for some time filled the office of civil surgeon there, records his inquiries thus:—

In 24 Indo-European families, 1 in $18\frac{3}{4}$ affected.
In 71 Native Christian „ 1 in $17\frac{1}{11}$ „

According to Mr. Waring,† the Jews (white and black) in the same locality exhibit a higher proportion, being in the ratio of 1 to 14½ nearly. Besides these classes, elephantiasis attacks, and that indiscriminately, other of the native races of India, as the Mussulman and Hindoo.

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* *Madras Quarterly Journal of Medical Science,* 1860, p. 37.

† Waring *On Elephantiasis, Indian Annals.*

In 100 cases, Mr. Day reports as follows:—

	Males.	Females.	Total.
Left forearm	3	0	3
Right lower extremity	17	10	27
Left "	11	13	24
Both extremities	18	13	31
Both lower and upper extremities	4	0	4
" right upper extremity	1	0	1
" left "	2	0	2
Both lower extremities and scrotum	1	0	1
Left extremity "	1	0	1
Right " "	2	0	2
Scrotum	3	0	3
Mammæ	0	1	1
	63	37	100

From this table it appears that no less than 93 cases of elephantiasis in 100 are those affecting the lower extremity. A smaller percentage is given by Mr. Waring; thus, in a collection which he made of 945 cases, 307, or 32·49 per cent., belonged to the lower extremity; 287, or 30·57 per cent., to the upper extremity; and 344, or 36·40, to both lower extremities.

Under the age of ten years, elephantiasis Arabum is infrequent. From the period of puberty to the age of twenty-five or thirty years it is generally observed. Owing to the prejudices of caste, it is difficult in India to determine anything like an exact ratio of its occurrence between the two sexes. There is little doubt that it is more common in the male than in the female, and probably the proportion of 2 : 1 would represent the nearest approximation. It is not a little remarkable, that while in Madras elephantiasis so much affects the lower extremity, in Calcutta it is the genital organs which are usually attacked. Sometimes the complaint undergoes a kind of metastasis, and leaves the leg altogether, only to show itself in the scrotum or other parts.

Although sudden in its attack, elephantiasis is attended by constitutional disturbance, which in some cases is severe. The patient shivers, or is cold, afterwards becomes hot, and finally is bathed in perspiration. This febrile state, which may continue for two or three days, is invariably followed by an increase in the local symptoms, with pain, or tenderness to the touch, along the course of the lymphatics of the affected part.

Elephantiasis of the genitals occurs in the penis or scrotum, or both. When originating in the former, the part becomes hot, swollen, and tender. The pain is not, however, limited to the scrotum, but is felt along the inner side of the thigh and at the groin. The form of the tumour is conical, having its apex above and base below. As the constitutional symptoms which usher in the complaint subside, the swelling decreases to a certain point; and with the recurrence of another attack similar symptoms return, and a corresponding accession is given to the size of the tumour, which may at length reach to the knees. Unless the swelling be great, it usually preserves its form, but the penis is concealed in its large folds. Sometimes the raphé deviates from the middle line, or cracks are seen, from the skin being suddenly and tightly stretched. Abscesses occasionally arise in different parts of the scrotum.

It sometimes happens that during the febrile paroxysm a clear discharge exudes from the skin of the scrotum. This is always a favourable sign, and seems to be an effort of nature to throw off the disease.

The *venereal* variety, according to Dr. Allan Webb,* mostly originates in the prepuce; or, in the female, in the nymphæ or clitoris. In the former it may attain several inches in length as well as in diameter; and, as Dr. Webb remarks, in this species the scrotum, instead of offering a smooth or plain surface, is tuberculated. In the female the labia are often more or less displaced on account of hypertrophy of the nymphæ, one or both of which may be enlarged. Warts are often present, which give rise to a foul secretion. In either sex the febrile attack which so often accompanies elephantiasis is altogether wanting. In this description, says the above author, speaking of the distorted condition of the parts, 'I have never seen such monstrosity in any instance where it was not reasonable to believe syphilis was the point of departure.'

Elephantiasis is frequently connected with hydrocele; and in a case that Professor Ballingall† operated on, he found, on removing the tumour, that he had inadvertently opened a hernial sac. The swelling in this instance weighed forty pounds, and although the after symptoms were at first severe, the patient perfectly recovered. Sometimes mortification happens, or the skin with the subcutaneous tissue sloughs, exposing the testes. Dr. Webb attributes the more immediate causes of this complaint to bathing in cold water when the body is heated; or to sleeping on damp ground, or to contusions. Elephantiasis of the genitals, like the same disease occurring in the lower extremities, is, without doubt, largely influenced by locality.

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* Dr. Allan Webb *On Elephantiasis.*

† '*On the Operation for Elephantiasis scroti, with Cases and Remarks,*' *Transactions of the Bombay Medical and Physical Society,* vol. viii., p. 232, by Assistant-Surgeon G. Ballingall.

As to the nature of elephantiasis, opinion widely differs. Many of those who, from their position in India, have had extensive opportunities of witnessing this disease, pronounce in favour of its malarious origin, and of the close connection existing between it and intermittent fever. In support of this theory Mr. Waring, whose experience is certainly considerable, adduces 226 cases of elephantiasis Arabum, of which no less than 224 had suffered from intermittent fever. There are, I think, strong objections to this view. In the first place it may be fairly questioned whether a febrile paroxysm, which happens but once in three, four, or six months, is at all identical with intermittent fever properly so called. In my own experience of the latter malady on the banks of the Indus, where it yearly prostrated a large percentage of our troops, I never observed the least tendency to elephantiasis among them, nor yet in the resident population. Again, the febrile paroxysm differs in the following particulars from fever of an intermittent type:—headache, approaching to delirium, is the rule in elephantiasis, the exception in intermittent fever, and there is not that enlargement of the spleen or liver which is seldom wanting to the latter in its confirmed stage. The pulse in intermittent fever is quickened during the hot stage: this is not the case in elephantiasis, nor do the remedies on which we rely for a cure of the one produce a sensible effect on the other.

In an early stage, and when situated in the lower extremities, an attempt should be made to reduce the size of the limb by even pressure. For this purpose cotton bandages, or, better still, a flannel roller, should be applied from the toes and carried beyond the line of the swelling. Ointment containing iodine, or iodine friction, will be also of assistance. In some cases the biniodide of mercury, in the proportion of one grain to four drachms of cerate, rubbed into the part, has been productive of benefit, and is recommended by Mr. Day. The first effect of its application, he says, is to occasion some irritative fever, and even an increase in the size of the limb, with more or less pain:

but as the latter subsides the swelling diminishes. Combined with this treatment absolute rest is essential. To improve the general health, bark may be given, but no remedy possesses a specific action on the disease. I have known it arrested by the above treatment, and in one case it seemed to lessen from the exhibition of small doses of mercury. How far any change of climate might prove of service in this country I cannot say, but a removal to a distant station in India, unless the complaint be far advanced, is generally followed by a remission of the local symptoms. The swelling may even disappear, but a relapse is almost sure to arise on the patient's return to his former abode. If this resource prove unavailing, or the complaint occur in a cold climate, the only alternative is amputation at or below the knee. The operation may be safely undertaken in so far as the disease is not likely to recur, and the patient's health warrants such a procedure. In those instances where the thigh is likewise invaded, deligation of the femoral artery has been recommended. It was originally proposed by Dr. Carnochan of New York, and one of the first to adopt it in this country was, I believe, Mr. Butcher, of Dublin. The patient recovered without a single bad symptom, and she was finally enabled to follow her occupation, which was that of a laundress. The difficulty in tying the artery in such a case is greatly increased by its unusual size, as well as by the risk of wounding, on account of their engorgement, the superficial or the femoral veins. Nor is this the only complication which should be well weighed before deciding to apply a ligature, whether to the femoral or the iliac artery, which has actually been done in elephantiasis of the lower extremity. In several cases, the benefit thus gained has been only temporary, and the disease has recurred, with no mitigation of its former symptoms, and after only a few months' interval.

In elephantiasis of the genitals the tumour should be removed. In the native hospitals at Calcutta and Bombay, these growths have been successfully amputated when they have weighed 100 lbs. and upwards.

In one case that came under the care of Professor Ballingall, at the Jamsetjee Jeejeebhoy Hospital, July 20, 1862, he commenced the operation by transfixing the neck of the tumour in the middle line, the knife emerging at the perineum. A strong double ligature was then passed through the opening, and brought up round each side. After tightening the ligatures by tourniquets, the whole mass beyond the testicles was rapidly removed by a double-flap incision. The tumour weighed, after removal, 106½ lbs. The after shock was very great, in consequence of reaction not being properly established for some days, and in consequence of a heavy loss of blood the following day. The recovery was, however, afterwards uninterrupted, and on September 4, the patient was discharged, cured.* G. N.

Frambœsia (yaws).—This is an exanthem rarely, if ever, seen in England; it has, however, been met with in the North of Scotland and in Ireland; it is common in the West Indies and Africa. At the onset there is slight fever, which is soon followed by an eruption of small flat papules, which increase in size till they attain a diameter of half an inch; the crop of papules is not completed at once; new ones appear whilst old ones are declining. The eruption is greatest, and the spots are largest, on the face, axillæ, arms, groins, and pudenda. After eight or ten days the eruption becomes pustular, and a crust is formed, beneath which a foul sloughy ulcer is found. On the surface of this ulcer red fungous granulations spring up. These ulcers exist in all stages on the body at the same time, and are often accompanied with ulceration of the throat. The eruption may continue from a few weeks to seven or eight months; after a time the sores contract and cicatrise, leaving no mark unless the inflammation has run high. The disease is followed by much emaciation and debility; and frequently by dropsy. Frambœsia is transmitted by contagion; it has been communicated by inoculation. It is rare amongst the white races of mankind.

Treatment.—Locally, mild stimulating ointments; internally, tonics, nutritious food, and occasional alteratives; aperients appear to be indicated. Mercurials have been used in former times, but are now generally believed to be worse than useless.

T. H.

KELOID TUMOURS.

The first to recognise keloid growths as a separate class of tumours was Alibert, who describes them as of a reddish colour, sometimes streaked with white lines, not pedunculated, but rather embedded in the substance of the skin. To the touch they are elastic, like fibro-cartilage, and moreover, they are not malignant.

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* '*On the Operation for Elephantiasis scroti, with Cases and Remarks,' Transactions of the Bombay Medical and Physical Society*, vol. viii. p. 233, by Assistant-Surgeon G. Ballingall.

Their origin, I believe, is derived from the cutis itself, and not from the subcutaneous tissue, which is seldom implicated. In structure they partake, and that largely, of the fibrous element, and are highly vascular; this is shown by the number of capillaries ramifying on their surface. The cuticle is sometimes wrinkled, but more generally remarkable for being soft and smooth. There is, in the College of Surgeons, a beautifully injected preparation, which was presented by the late Mr. Edward Stanley.* It is an ordinary keloid growth of the leg, resulting from a scald, and extending several inches in the form of a tumour, narrow and not much raised. Its uniformly red surface contrasts with that of the surrounding skin; and, except where it has been removed by ulceration, the epidermis is intact.

Keloid tumours present great variety of appearance. The growth may be confined to a single tumour, smooth, ovoid, and hemispherical; or several of these may be seen at short distances from one another, and in various stages of development. Again, the part affected may be distinguished by irregular but not prominent projections, traversed by numerous bands, or sending out processes or claws in the direction of its growth. As the consequence of a cicatrix, the form of the tumour will correspond to the extent of the primary lesion.

In its early stage the growth is not usually painful, but its character in this respect is often much modified by the health or temperament of the patient. Thus, should there be a tendency to hysteria in the female, or over-sensitiveness or irritability in the male, more annoyance will be experienced from the presence of the tumour than where no such disposition prevails; and this is what we might expect. In many instances no inconvenience is felt, unless the part has been much manipulated, when it itches, or is said to 'burn'; or unless it be constantly pressed upon, as for example when occurring on the scapula in a line with the border of the dress. Sometimes the patient complains of pain, which the least handling increases. At a later period, should ulceration take place, pain is always more or less felt, but it is not determined by the size or growth of the swelling.

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* Preparation 2,283 B.

Keloid tumours are not limited to any locality. Perhaps they may be said to be more common over the scapula, and next to this the sternum. Sometimes they show themselves on other parts of the trunk, or upper extremity, or face, and seldom on the lower limbs.

However obscure the real origin of these tumours, a singular predisposition to their production is declared in certain constitutions, whether in the development of new growths or the recurrence of a similar swelling from the cicatrix of one that has been removed. Velpeau relates the case of a lady, from whose breast he excised a tumour of this kind, and who had undergone the operation on two occasions before she applied to him, and again it appeared for the fourth time.* It would be easy to multiply such instances as these. The same liability to return is often observed when, instead of excision, the mass has been destroyed by caustics, or removed by ligature; and so great is it in some cases that the apertures caused by the needles in closing the wound have shortly become each the seat of a keloid tubercle. In one example, which Mr. Longmore lately brought before the notice of the Medico-Chirurgical Society,† the whole of the back, the greater part of the chest and the face, were studded with keloid excrescences; the only evidence of an exciting cause was afforded by a 'prickly heat,' to which the patient, a soldier, had been exposed while serving in India. The disease was aggravated by the use of the cross-belt, and scarcely, if at all, increased in the cold weather. This man had never suffered from small-pox or secondary syphilis, and I may add that he was doing duty in the Deccan, where prickly heat is far less severe than in the plains of Hindostan. The effect of some injury to the skin is in most cases the immediate cause of a keloid tumour. Among soldiers it not unfrequently follows flogging; in other cases it succeeds gun-shot wounds, and particularly burns. The scars of small-pox or rupia, and even leech-bites, have been known to become the deposit of keloid substances.

There is a species of keloid to which Addison has drawn attention, and which he describes as true keloid. How far it merits this distinctive title I am not about to discuss; but that the term keloid tumour cannot appropriately apply is, I think, sufficiently evident to any one who examines the models from the originals of which the observations of Addison were derived. Commencing as a white spot, it sometimes spreads in a circular, but more commonly in a linear direction, and in many cases is attended by no elevation of the surface. The skin appears infiltrated, or, to use his own words, 'hide-bound,' and this so far affects the subjacent fascia and muscles as to interfere greatly with their free motion. Generally the skin is of a yellowish colour, and the patch is more or less covered with scales.

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* Velpeau *On Diseases of the Female Breast,* translated by W. Marsden, M.D., 1856, p. 57.

† *Remarks on two Cases of Kelis,* by T. Longmore, vol. xlvi. p. 105.

In the treatment of keloid tumours we should remember, that they are sometimes much affected in their growth by the state of the general health, and that they occasionally disappear. The influence of these conditions should not be overlooked or undervalued, as although the removal of the mass may be readily performed, the risk of its return is always considerable. We may endeavour to promote absorption by painting the part with tincture of iodine, diluted at first, and gradually used pure; or collodion may be employed with a similar object. In one instance related to me by Dr. Broadbent of extensive keloid growths, the latter disappeared or became much reduced from the internal use of iodide of potassium; and in a case of doubtful origin it may be worth while to try the effect of this remedy. The contra-indications to an operation are these:—1st, when the disease shows an inclination to become developed in other parts—in such a case, if excised, it is almost sure to recur; and 2nd, when it has already been so extensive as to preclude any resort to the knife. In these no treatment that I am aware of is of any avail. Rayer, indeed, recommends pressure, but this is more likely to increase than mitigate the evil that already exists. G. N.

Gross, in his 'System of Surgery,' describes, under the names 'eiloid' and 'lepoid' two diseases not mentioned by most other authors.

Eiloid is a name given to a tumour of the skin very rarely met with. It was so called by Dr. J. C. Warren, of Boston, from its peculiar coil-like disposition. It presents at first the appearance of a small elevation, somewhat like that caused by a burn; it goes on to increase without pain, heat, redness, or ulceration, until it attains a large size, and sensibly affects the general health. The case described by Dr. Warren, was that of a negress, aged fifteen, who had not been in good health. The disease assumed the shape of coils lying side by side, each about four inches long, and looking like a triple coil of inflated intestine. The tumour was removed with a portion of sound skin, but soon returned; it was again extirpated, but rapidly reappeared; and the patient shortly after became dropsical, and died. There was serious disease in the liver, ascites, and enlarged mesenteric glands. Of the anatomy of eiloid nothing is known; it is said to take its origin in the derma.

Lepoid is described under LUPUS. T. H.

MACULÆ, OR PIGMENTARY CHANGES.

These changes are seated in the deeper layers of the epidermis, the so-called rete mucosum. They may be classed under two heads: 1, those in which there is excess of pigment; 2, those in which there is a deficiency of pigment.

(1) *Excess of pigment.*—Different races of man exhibit very different amounts of pigment in their skin; the natives of hot climates have much, and those of cold climates little pigment. Developmental changes in the organs of reproduction are often attended with an increased production of pigment; and at the age of puberty there is commonly a darkening of the skin of the sexual apparatus. During pregnancy the areola around the nipple becomes of a darker colour; rare cases have been described in which this discoloration has extended at this period much further, even over the whole front of the body. During menstruation the lower eyelids are often discoloured, sometimes from a sort of venous lividity, in others from real pigmentary deposit. Heat and light have the effect of increasing cutaneous pigment, either uniformly or in spots, called freckles (*ephelis*). Yellowish brown, round or irregular, spots or patches are thus produced on exposed parts, especially in persons of fair complexion. When spots of this kind are more permanent than usual, they are called *lentigo* or *ephelis lentigo.* The skin on the front of the legs of old people often becomes of a brown or liver colour; this change is said to depend on exposure to artificial heat. Many skin-diseases leave the skin with an excess of pigment, especially psoriasis, eczema, and prurigo.

Cases are on record in which mental emotions have suddenly induced an excessive formation of pigment; it is more common, however, to see from this cause, in the hair, which is homologous with the epidermis, a loss of pigment. The whole hairy scalp has been said to have become grey in a few hours from intense anxiety or grief.

Dr. Addison first called attention to a peculiar discoloration of the skin (a bronzing), which he connected with disease of the supra-renal capsules; it is accompanied by progressive debility, anæmia, occasional giddiness, and gastric disturbance, and terminates fatally at the end of a few years. The colour of these patients is brownish, with sometimes an olive-green tint, and it very closely resembles that seen in the darker races of man. The depth of tint varies in different cases, being most marked in the parts most exposed, and also those in which there is normally an excess of pigment; as, for instance, around the axillæ and near the umbilicus. The pathological connection between the cutaneous change and the supra-renal disease is not very obvious; it has been supposed by some that they are both dependent on irritation of the solar plexus of nerves. It appears, at any rate, to be satisfactorily proved that a bronzing of the skin, accompanied by certain constitutional symptoms, not traceable to any other cause, may be safely assumed as pathognomonic of a peculiar morbid change in the supra-renal capsules. The capsule is first changed into a translucent softish homogeneous substance, which after a time is converted into an opaque yellowish material, and at a later period into a putty-like matter, or a dry chalky mass.* Other changes occur in the supra-renal capsules, without pigmentary change of the skin, and on the other hand the skin may undergo discolorations very similar to, if not identical with, those accompanying Addison's disease, without the peculiar constitutional symptoms or disease of the capsules. A case of this kind is described by Dr. Parkes, in which the skin of a man aged fifty-nine years, five months after an attack of jaundice, became gradually dark on the body, arms, and thighs, until the hue was that of the skin of a mulatto; over the abdomen, thighs, and scrotum, there were white patches interspersed; below the knees the skin was of its natural colour. In this case the supra-renal capsules were found quite healthy; the liver was contracted, and had given rise to ascites. Similar cases are also on record in the Pathological Society's *Transactions* (as *e.g.* vol. xii. p. 262); other instances have been met with, in which the skin was mottled with dark and white patches; two such cases are mentioned by Dr. Addison, and considered by him to belong to the same category of supra-renal disease. In one of Dr. Addison's cases, the capsules were diseased; in the other no post-mortem examination was made. Dr. Wilks doubts whether this peculiar mottling, a combination of bronzing with pallor, or *leucopathia*, is in any way connected with supra-renal disease.

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* Dr. Wilks, in *Guy's Hospital Reports,* vol. viii.

Moles (nævi lenticulares, or liver stains) are congenital spots or patches on which there is an excess of pigment.

They are sometimes round, sometimes of irregular shape; and they have either a brown, yellowish-brown, grey, or blackish colour; occasionally they are covered with hairs, which are thicker, stiffer, and darker than the hair of the adjoining skin.

In size they vary from a pin's head to a diameter of several inches. They are either quite flat, or raised above the level of the surrounding skin. There may be one or many of them on one person.

They are formed by an excess of pigment in the deeper layers of the cuticle; which is often thicker than it is on other parts of the surface: and in those moles which project above the level of the skin there is a thickening also of the derma.

They are occasionally the seat of troublesome ulceration, from friction or other cause. In such cases it may become advisable to excise them; and this is the more desirable since they are believed to be often the seat of epithelial cancer in after-life.

(2) *Want of pigment.*—This may be congenital and universal, involving not only the skin, but the hair, the iris, and the choroid, constituting *albinism*. Several albinoes have been met with in the same family, or one member only of a family is affected. Albinism has been observed to be transmitted by inheritance to one sex more than to the other; in one family preferring males, and in another females. This affection occurs occasionally in all races of mankind, but is more common in hot than in cold climates. There is intolerance of light, and usually a want of power both in body and mind.

Partial loss of pigment is also more common amongst the darker races, at any rate it has been more noticed amongst them. Negroes congenitally 'piebald' are by no means very uncommon.*

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* The pigment is sometimes unevenly distributed, so that there is an excess of it in some parts and a complete loss of it in others.

Vitiligo is a term differently used by different writers. It is now commonly employed to designate patches characterised by loss of pigment. In some cases there is a slight depression of surface in these white patches, with branny desquamation.

Silver stain.—The internal use of the salts of silver for a long time produces a peculiar livid or slate-coloured tint of skin. No remedy is known for this condition.

Besides the changes of colour above described, there are some rare cases on record in which a free excretion of pigment has taken place on the eyelids; in some cases black, in some yellow, and in others blue. The fluid in which the pigment appears is somewhat unctuous, and the affection has hence been called stearrhœa nigricans, flavescens, and cærulea.* The secretion may be wiped off; but appears again at the end of a few hours. The subjects of these cases have generally been women who have suffered from uterine derangement; some of these changes have no doubt been simulated by hysterical patients. Whether the secretion has come from the sebaceous glands or sweat-glands has not been clearly demonstrated—probably from the former.

T. H.

XERODERMATA.

Ichthyosis is a complaint properly classed with the squamous group, and when seen in certain examples, presents a remarkable disease. The name, derived from a fancied resemblance which its scales bear to those of a fish, refers rather to their abundance than arrangement, as the absence of any imbricated method marks the complaint in every stage and variety. In many cases the scales are very thick, disposed as so many small squares, and often rendered dark or nearly black from continued exposure; they are specially developed in the vicinity of the joints, as the knees, ankles, and hips; occasionally also the clavicle, and in females the circumference of the nipple.

A good illustration of ichthyosis is afforded in the following instance of S.B., a girl fourteen years of age, admitted into Hospital in 1864. The scales covered every part of the body, except the soles of the feet and the palms of the hands, where the skin was only rough; they were also absent on the ball of the thumb and the upper lip. Their greatest development was attained on the hips and elbows, but the neck, back, and outer surface of the limbs were severely affected. The large scales were irregularly fissured, and some of them curled at their margins. Thickest on the knees, they existed as large flakes on the abdomen and the thighs. The forearms on either aspect were covered with dark rectangular scales, which became circular or oval towards the wrist, and slightly depressed in their centre.

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* Dr. Laycock, *British and Foreign Med.-Chir. Review*, vol. xviii.

Although always congenital, ichthyosis is never contagious, and in every case should be considered rather as a malformation than a disease.

Such are the characters of ichthyosis as they occur in extreme examples. There are, however, many cases no less typical, but which differ from the preceding chiefly in the disposition of the scales. The latter are notable for their size and tenuity, as well as for the rapidity with which they are shed and again renewed. The skin also inclines to a reddish hue.

In a *third* kind, an intermediate stage is represented between what might be termed pityriasis and ordinary ichthyosis. It is a far more frequent species than those just described, and its scales are thinner and more abundantly diffused than in the latter affection. In common with the rest, this complaint is congenital, and as such it differs from hereditary psoriasis in not being declared, or at any rate most rarely so, at the time of puberty, or yet at a later age. The most usual period for its primary manifestation is from the third to the sixth month, and seldom is it delayed beyond the first year. It commences generally on the scalp and face, sometimes on the back, extending from thence over the whole surface, and varies from one to two or more years before its entire effect is accomplished. In some of the worst instances of its occurrence, it is associated from birth with a deficiency of the eyebrows and eyelashes; and in cases less pronounced these may be but partially present. Although at its origin the face is usually involved, the disease in its progress sometimes appears partially to forsake this part, and to become finally more confirmed on the loins and legs. The patient's garments or bed-clothes, as in psoriasis inveterata, will be constantly covered with numerous scales, which are regenerated almost as soon as shed. The skin everywhere feels preternaturally rough and dry, not excepting the hands and feet; and one distinguishing element of the complaint to be often noted consists in that absence of perspiration which, in cases of severity, would seem to be complete, the skin retaining its dry character even in the hottest day. As might be anticipated, the condition of the patient thus situated depends in no slight measure upon the seasons, the disease being found to yield to the influence of mild weather; while, on the other hand, it is readily affected or increased by cold. In winter, or in a piercing wind, the patient is pretty sure to suffer, particularly on any surface uncovered, as the face or fingers; or should he afterwards approach the fire or become otherwise heated, the same parts tingle and smart. A similar result will sometimes follow exposure to the sun's rays in summer; which, without flaying the skin, produce great irritation in such a locality as the face. In other cases the feet, around the heels, are apt to become fissured and painful after walking, or much inconvenience is occasioned from the friction of the scales in front of the ankle or at the groin.

A yet lower type of ichthyosis—the lowest of all—I would beg to subjoin. The subjects of it are distinguished by a similar want of perspiratory action of the skin as in the last named or by its limitation to some particular region. This may be, and most generally is, the palmar or plantar surface, or the axillæ, or the face and neck; and I have known a small space on the loins, or the front of the chest, the only part capable of secreting. Sometimes the spot thus selected constantly perspires, or it is only the great heat of summer which induces it to do so. Again, the presence of scales, although so prominent a feature in all other forms of ichthyosis, is not remarked here; and scarcely can the hand, much less the eye, detect any appreciable difference in the integument from that of the normal state. Such patients are often remarkable for a redness or freshness, as it might be said, of the cheeks; and particularly is this noticeable after the least excitement or exertion. That these cases do in reality pertain to the class under our present consideration is sufficiently attested by the hereditary nature of the complaint, and by the evolution of its higher grades in other members of the same family; and not seldom its occurrence in direct descent. One complication I must likewise add, which, almost always overlooked, deserves mention in this place—I mean its occasional association with prurigo. The latter is in many instances severe, and productive of the utmost annoyance to the patient, whom it may affect at any age, from early life to youth, and beyond it. Towards night especially, exacerbations are wont to occur, as on approaching the fire, or the same takes place from exposure to cold. That this kind of prurigo is dependent upon the state of the skin itself, and not due to any parasitical influence, is, I think, proved to demonstration by the absence of any such exciting cause, and by the remedies successfully employed for its removal.

The total arrest of all sensible perspiration in ichthyosis, and its partial secretion only in some of the modified forms of this complaint, offer an interesting subject for investigation with respect to the state of the urine. The result of certain experiments which I undertook some few years since on this question, and to which I would beg to refer the reader,* pointed to the following conclusions. A considerable increase in bulk was observed in the urine, which was only faintly acid, and of low specific gravity; the rate per cent. of urea was small, although its absolute amount remained nearly the same—a fact which militates against the usually received theory of the elimination by the skin of urea; lastly the phosphoric and sulphuric acids were hardly if at all affected.

Most writers have dwelt on the greater frequency of ichthyosis in the male as compared with the female. My own observations, derived from no inconsiderable number of cases, rather incline the other way, and certainly do not support the opinion that ichthyosis is a special complaint of either sex. Instances have come under my notice of ichthyosis invading the male children only in one family, and in another the female; of its affecting both sexes, the offspring of the same parents; and again of its appearing in a single member alone. The hereditary nature of ichthyosis in some examples is unquestionable; and I have recorded one, in which there was evident proof of the direct transmission of this affection through six successive generations. Instead of proceeding in an immediate line, it will sometimes show itself in a collateral branch of the family; and cases are not rare in which, as far as can be ascertained, no claims of lineage are allowed.

Ichthyosis may exist in the fœtus, and in a most aggravated stage. In these cases, the skin appears tightly stretched throughout, and over the trunk and limbs it is ruptured in transverse or parallel lines. The eyes are fixed in consequence of the rigid state of the lids; so likewise are the lips, which are converted into hardened bands, and expose the gums; and no vestige of an external ear is seen. The entire body presents an assemblage of lozenge-shaped spaces or intervals, caused by a separation of the fibres of the cutis, sufficiently numerous and distinct to warrant the appellation of a 'harlequin' fœtus, which is allotted to it. The only museum, as far as I am aware, in the possession of this remarkable class is that of Guy's Hospital, which contains four excellent specimens of this singular deformity of the skin. Although it is to be regretted that no history is attached to them, I was fortunate in learning from Mr. Scarr of Bishop's Stortford, who presented one of the above preparations to the Hospital, that not only was the mother's labour in this instance perfectly natural, but the fœtus lived for some seconds after its birth: it was the only one of several children that exhibited any indication of ichthyosis, and no hereditary trace could be obtained. I may add, that by the parent the complaint was attributed to a sudden and severe fright she experienced, when attending a country fair at the time of quickening.

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* Nayler, *On Diseases of the Skin*, p. 64.

Hitherto I have considered ichthyosis as general, and therefore complete; but it is by no means invariably so. Instances are often met with in which it occurs only in a partial form. These betray a roughness of surface varying in degree and extent in different cases, but chiefly observed on the outer aspect of the limbs and the loins, and most of all in the vicinity of the knees or other large joints. We shall here search in vain for any indication of the eruption on such parts as the face, hands, or feet. The scalp participates, but irregularly; it may exhibit at a single spot a large, thick, and irregular crust, very adherent, and covered with hair; or in other cases, separate white patches, scarcely raised, but equally tenacious as the last, and penetrated at various points by hair. In the regions which are thus devoid of any squamous characters, perspiration will frequently be found continuous and excessive, as if to compensate for the more general deficiency of the same secretion elsewhere; nor even in winter is it altogether deficient, particularly in such places as the palm and sole. In one respect this excess of perspiration proves a boon to the patient; for in consequence, as will be presently remarked, no feeling of irritation is caused by the disease. The latter is an inconvenience, but no more; nor is it much influenced by those changes of climate or weather which otherwise aggravate the complaint. Again, partial ichthyosis is sometimes very restricted in its locality; and I well remember a young lady, a private patient of Mr. Startin, in whom this disease was entirely confined to the palmar and plantar surfaces. Her father was similarly but less severely affected, while the rest of the family were quite exempt. Still more recently, an example of this rare affection came under my care at the hospital in a young woman, twenty years of age, who likewise had the complaint limited to the hands.

A case in private is now under my observation, of an adult patient, who perspires everywhere except in the face, which is always dry, even in the heat of summer, but without any appearance of scales: of his two children the younger, aged three years, is an instance of general ichthyosis, while the other, some years older and also a boy, is entirely free from any appearance of it.

From what has now been stated of ichthyosis, it will be seen that I have used the term in a far more comprehensive sense than has hitherto been assigned to it. Considered from this point of view, there are few cutaneous disorders which offer so many and at the same time such distinctive degrees of comparison. A malformation of the skin rather than an actual disease, it varies from a general roughness of the surface, and even this may be scarcely perceptible, to a condition of the utmost severity, as in the harlequin fœtus; between these two extremes every connecting link in the chain of development is complete. If I may hazard a conjecture, and something more than a conjecture, I would say that, whatever type the complaint originally assumes, its tendency is always to revert to that state, and most seldom to exceed it. We do not find, for example, the lower varieties of ichthyosis, however modified they may be by external causes, attain a higher or more advanced grade; nor, on the other hand, does partial ichthyosis pass into a more general form. I would also mention that scarcely a single case of ichthyosis has passed under my notice, unattended by a peculiar malformation of the external ear, and notably of its lobe, which might be taken as no mean exponent of the degree of the primary disease involving the skin. My attention was first directed to this inquiry when examining a harlequin fœtus, in which no trace of an external ear remained; and, in proceeding through successive deviations from this example, a corresponding diminution in the extent of malformation was observed, until the opposite limit was reached. The only apparent alteration then consisted in the lobe being connected with the adjoining surface of the cheek, of which it seemed to constitute a part.

Allusion has been already made to the complication of ichthyosis with prurigo; that with eczema will demand a few words. The occurrence of eczema, although sufficiently rare, is chiefly found in ichthyosis when the latter is partial rather than complete. In some instances, the eczema, if slight, would seem to be accidental; but I am disposed to conclude that in the greater number the complication should be regarded as congenital, returning as it mostly does in the course of a few months from the date of the original disorder, and with an inclination to harass the patient more or less afterwards. At first it is the face or scalp which commonly suffers, and then the complaint spreads to other parts, as the neighbourhood of the larger joints; and thus we find that, while the outer aspect of the extremities is uniformly rough and harsh, the inner surface is studded with eczematous patches. These vary in degree at different periods; but seldom, under the most favourable circumstances, is the skin wholly free. Sometimes the eczema developed in ichthyosis is due to syphilis, which may be delayed in its outward manifestation until the second or third year; later than this, no instance has come under my knowledge. They are amongst the most severe in all that concerns the extent of the eruption and the attendant irritation. As a rule, they are unaccompanied by loss of flesh or syphilitic cachexia.

Among the occasional accessories of ichthyosis, for the name of complications they hardly deserve, may be enumerated an undue escape of the lachrymal secretion. This happens in those cases where, from the rigidity and consequent retraction of the skin of the cheek, the lower lid is everted; the eye becomes suffused, and soon the tears overflow the face, thus creating an annoyance which the patient is altogether unable to prevent or control. Another, and a more common attendant, inasmuch as it generally selects the milder examples, is the occurrence of coryza, and with it an inflamed condition of the Schneiderian membrane at its lower part. The coryza is often easily provoked, and may continue unchecked throughout the winter months. Again, the subjects of ichthyosis, it may be observed, are more than others liable to bronchitis or catarrh, or they suffer habitually from cold to a far greater extent than ordinary persons. On the other hand, where no apparent outlet is afforded in any portion of the skin, the extreme of heat is still more dreaded in certain instances, although they happily constitute a minority. It is not mere exposure to the sun's rays, or any kind of extraneous warmth, which awakens this burning sensation in the skin, once forcibly expressed to me by a patient upwards of seventy years of age, who had had general ichthyosis, I need not add, all her life, or nearly so. The heat of summer alone is enough to induce it.

There is a species of so-called ichthyosis to which the name of *spurious* has been given by some writers. It is a product of the sebaceous glands, and has no connection at all with the disease under review. In another kind, *ichthyosis cornea*—as remarkable as it is rare—I must refer the reader to what I have elsewhere mentioned on this subject. The name would seem to have originated from a tendency often noted in this disease to produce excrescences on various parts of the affected surface which, by their increase, become developed into horns.

The prognosis of ichthyosis, in its several varieties, is unfavourable as regards complete or permanent relief; but the complaint is, nevertheless, in most instances greatly amenable to treatment. After a time, the skin becomes smooth, and scales are no longer renewed—a source of no slight satisfaction to the patient. The malformation, however, in any case remains; and with it a disposition to the return of the disease, which may be provoked by many causes, such as exposure to atmospheric changes, or the neglect of precautionary measures; and it is to the non-fulfilment of the required conditions, in so far as they relate to the general health and the state of the skin, that a relapse is mostly attributable. I have known ichthyosis successively relieved, and to such a degree, by the warmth of summer alone, that during the season it could scarcely be said to exist; but, with the approach of winter, its true character never failed to be declared. In this class, which may be said to be restricted to the less serious cases, and only a particular section of them, there is no doubt that a removal to a more genial climate than our own would be followed, for the time at least, by a tolerable exemption to the patient from his complaint. I have now under observation, in the private practice of Mr. Startin, a boy aged eleven years, the subject of ichthyosis, who is a singular exception to a very general rule in this disease, inasmuch as in the summer months he derives the greatest benefit from a residence at the seaside, and even from bathing in the sea. The first example of ichthyosis recorded at the commencement of this paper is a notable instance of how much may be gained by remedial measures properly applied, the patient being enabled to return to her ordinary duties as a domestic servant with comparative comfort as regards the cutaneous disorder, thus kept in abeyance. In the milder cases, in which, although general, the limits of pityriasis are scarcely exceeded, much, and at the same time, more lasting benefit will likewise accrue from remedial agency; and the same applies with equal if not greater force to ichthyosis in its partial form. In that kind, which is distinguished by the extent and thinness of the scales, and where the surface partakes more or less of a reddish tinge, the probability of even marked improvement, in my experience, is remote. In these, the severity of the disease is less determined by the size and thickness of the cuticular products than by the general completeness of the complaint; and of this we have sufficient proof in the exposed mucous lining of the lower eyelids and the lips, as well as in the malformation of the external ear. There is also much liability to exacerbations and remissions, a sense of aching and burning generally preceding an attack. The fingers are then apt to contract in the flexed position, and likewise the elbows and the knees. As a consequence, transverse cracks speedily arise over the phalangeal articulations, or fissures form at the side of the elbow or the neck, or on the loins. While this condition lasts, the patient's distress may be imagined from the very helplessness it entails; and I am acquainted with such a case, in which, during an attack, the patient cannot move in bed or feed herself without assistance.

In the treatment of ichthyosis, local measures will be found of great service. Our first endeavour should be directed to get rid of the scales, and to render the skin as far as possible soft and supple. This is best accomplished by the aid of glycerine, a valuable agent in many diseases, as was first pointed out by Mr. Startin, who introduced it to the notice of the profession many years ago. Unlike other greasy or fatty compounds, it is readily miscible with water; and hence its efficacy in removing, or at least in diminishing, the excessive dryness of the skin in ichthyosis. It may be turned to account in several ways. As a bath, in the proportion of six to eight ounces to thirty gallons of water, and at a temperature of 94 to 96 deg., it will prove most agreeable, and may be resorted to two or three times a week. Although it signifies little at what time of the day the bath is employed, I generally advise its use in the afternoon or at bedtime, as at the latter period it mostly secures a good night's rest; and in winter particularly, with proper precautions, the patient runs little risk of catching cold afterwards. The high price of glycerine is, however, often a bar to its use in this manner, from the frequency of repetition it entails; and it will then be enough for the patient, after taking an ordinary warm bath, to sponge the whole surface with a quart or more of warm water containing two or three ounces of glycerine; or he may use the latter undiluted, while the skin is still wet. This last is not only an economical mode of employing glycerine, but it is one of great service, as thereby much of its greasy character is lost, while the skin retains its pliability for several hours. In many cases, the bath is impracticable; in such, the patient should be told to grease the surface with an ointment containing camphor and glycerine—ten grains of one and sixty minims of the other to each ounce of lard. This is to be applied with a fold of flannel, and any excess removed by the same means. Sometimes, in lieu of an ointment, castor-oil is preferred; while any objection to its odour is readily obviated by the addition of a few drops of oil of bergamot or bitter almonds.

This comprises all I have to say as regards local remedies. When the scales are very thick, and not readily removed with friction or soaking in warm water, a piece of pumice-stone will often assist in detaching them, or the use from time to time of glass cloth, such as is employed for polishing. The thickness is most marked in ichthyosis of the palms of the hands, or when it appears on the foot or around the heel.

As regards the general health, tonics, especially those containing steel, will be commonly indicated; and of these none are better than the sulphate or the perchloride. These it is, in most cases, advisable to combine with an aperient, from the tendency they naturally possess to produce constipation. The diet should be nutritive, consisting largely of animal food, and at the same time plain.

While the above remarks were passing through the press, an opportunity has been afforded me of observing a rare example of ichthyosis cornea. The affected surface comprised the greater part of the skin covering the right clavicle, the elbows, knees, and ankles; also the backs of the hands, including the digits. In these localities, the skin presented a smooth, almost glistening, appearance, and was, moreover, of a yellowish hue. It had lost its natural elasticity, and felt indurated to the touch, like a piece of cartilage, from the subcutaneous tissue being likewise involved, and adherent above. There was contraction, in the semi-flexed position, of all the fingers—more evident on the right hand than the left, from its longer duration, and evidently produced by the same cause. A similar state existed on the toes.

The patient I refer to is under the care of Mr. Startin, whom she consulted for the first time, June 1870. Her age is forty-seven. The catamenia ceased two years ago, when the above complaint commenced, which it did on the chest; and since then it has appeared in other and distant parts. There is no lack of perspiration generally; but she suffers much from exposure to cold, particularly in the extremities. Pain is felt chiefly over the knuckles and in the feet, especially along the plantar fascia; and so severe has it become of late as to occasion much difficulty in walking. There is no evidence of the affection being at all hereditary.

The extreme infrequency of this form of skin-disease, described by French writers as *sclerema*, must plead my excuse for thus placing it on record. So nearly does it correspond in many essential points to a similar case described by Willan in his work, page 209, that there is no difficulty in recognising it as an instance of what this close observer has been pleased to call ichthyosis cornea. In all that concerns, however, its more obvious characters, as well as in the free perspiration of the surface generally, and the development of the complaint at a so-called critical period of life, it is distinct from that class which, in its several grades, I have ventured to express under the common term ichthyosis. Indeed, its sole claim to the latter designation rests on the horny state of the integument, which has already occasioned permanent flexure of the digits, and threatens, unless checked, to lead to more extensive results. G. N.

DISEASE OF THE HAIRS.

Plica polonica (*der Weichselzopf*, Germ.) This is a disease of the scalp which is endemic in Poland, Livonia, some parts of Russia and Tartary, beyond which countries it is scarcely known.

The real nature of this disease is not yet clearly proved. What is visible to the naked eye is a firm matting together of the hairs, and the presence of a sticky material between them. The matted hair sometimes takes the form of a single long tuft, sometimes of several smaller tufts, and sometimes of an irregular mass, forming a kind of cap. The disease is usually confined to the head; but is sometimes met with on the chin, in the axillæ, and on the pubes. There is pain and great tenderness of the scalp, which bleeds on the slightest touch.

It is doubtful what is the source from which the sticky material between the hairs proceeds. Fuchs believed that it came from the hair-follicles; G. Simon regards it as an abnormal secretion from the surface of the skin, not especially implicating the follicles. When it is examined microscopically, it is found to be made up of epidermis, threads of cotton, silk, and wool, with particles of sand, insects, &c. Sometimes, especially in cases of long standing, cryptogamic vegetation is found amongst it. The older writers described the hairs as thickened, swollen at the roots, and infiltrated with sticky reddish or reddish-white fluid. Later writers have not confirmed these observations. G. Simon* found no change in the hair, either at the root or in the shaft; it was not brittle or infiltrated with any abnormal material. He could not find, as stated by Günsburg, any vegetation in the hairs themselves.

On chemical examination, the peculiar matter has been found to consist of extractive matters, with ammoniacal compounds, fats, and fatty acids; with some salts, especially chloride of sodium, sulphate, phosphate, lactate, and acetate of soda; with but little potash, magnesia, iron, and silica. These analyses throw no light on the nature of the disease.

It has been suggested by Hebra, that plica polonica is not a distinct disease, but eczema, or other skin-affection, much neglected. This theory obtains some plausibility from the circumstance that in Poland there is a popular prejudice that this condition of the scalp is a cure for other maladies. On the other hand, it is not confined to the poor and ignorant, and is met with beyond the limits of Poland. T. H.

WILLIAM JENNER,
THOMAS HILLIER,
GEORGE NAYLER.†

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* *Die Hautkrankheiten*, p. 388.

† The sections of this essay signed G. N. are by Mr. Nayler; those signed T. H. by the late Dr. Hillier; the rest by Sir W. Jenner.

PART II.

LOCAL OR SURGICAL AFFECTIONS OF THE SKIN AND ITS APPENDAGES.

CORNS.

CORNS in their origin are merely local hypertrophies of the epidermis, situated for the most part on the feet, occasionally upon the hands, and more rarely over the prominences of the elbows or knees.* They are produced by intermittent pressure or friction, localised either by the natural prominence of the part affected, or by the peculiarities of the exciting cause.

Thus, on the feet they are produced by the irritation of ill-fitting boots. These, either from being too small, subject the most prominent points on the foot to undue pressure, or more generally, from being misshapen or too large, chafe and irritate the feet in walking. The peculiar distortion of the toes occasioned by short shoes,—namely, the extreme contraction of the flexor tendons, the doubling-under of the extremities of the toes, and the dislocation of their phalanges on the dorsal aspect,—this predisposes to the formation of corns. Arising from this cause, they usually occur on the flat ends of the toes, which press downwards against the sole of the boot; or on the dorsal surface of one of the phalangeal joints, which, being unnaturally prominent, are thereby exposed to friction against the upper-leather. In a less degree, tight stockings are a cause of corns, by crowding the toes and hindering the even spread of the foot in walking. On the hands these growths may occur upon the palms or upon the knuckles: they may be produced by the friction of the thimble in tailors and sempstresses. In such as play upon the harp and violoncello they are often found on the palmar surface of the finger-ends and thumb; and more rarely the friction of the pen in writing will be sufficient to produce them on the second finger or thumb. Again, the peculiarities of certain manual occupations may excite their growth upon the prominences of the knees or elbows.

From the occurrence of corns in very young children as soon as they begin to walk, and from their prevalence in certain families where both parents are sufferers, it cannot be doubted that a predisposition to their growth may be communicated by hereditary transmission. As has been mentioned above, intermittent and frequently repeated irritation, by friction or pressure of a *certain degree*, is required for the production of a corn. This acts by stimulating the cutis to the formation of an undue amount of epithelium, forming the characteristic thickening of the cuticle. Should the irritation, however, be excessive, either in its degree or its duration, effusion of serum between the cutis and cuticle takes place, and a blister instead of a corn results.

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* A case is related of a corn occurring on the tongue at King's College Hospital, under Mr. Hulke's care. *Med. Times and Gazette*, 1861, p. 556.

Corns may be broadly classed under the term *hard* and *soft*. The hard may be either flat and horizontally laminated in their structure, or fibrous and vertical in the arrangement of their parts. Again, in various stages of their development corns differ in their connections with surrounding tissues.

If a hard flat corn be examined in its earliest condition, it will be found to consist of a simple thickening of the cuticle, not well defined in extent, in shape somewhat like the flat head of a nail, and composed of epithelial scales, condensed, and having a regular horizontal lamination in their arrangement. By maceration such a corn may be completely separated from the cutis, leaving the subjacent papillæ distinct and well defined, and in no way altered from their normal condition. In its further progress the growth becomes more clearly circumscribed, and, increasing in thickness, produces greater pressure on the parts beneath. In old-established corns, situated over the phalangeal joints of the toes or some other prominent point of bone, this pressure and continued irritation generally gives rise to the formation of a bursa beneath, though the occurrence of a subjacent bursa is by no means an invariable consequence.

From the examination of corns that have evidently existed many years, and have from time to time been subjected to treatment, it appears that the long-continued pressure and frequent removal of the upper layers of the cuticle may at length lead to complete absorption of the papillary structure of the skin. Such corns may be found based upon the fibrous tissue of the sheaths of the extensor tendons of the toes, all intermediate structures having been absorbed.*

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* Cruveilhier, in tom. iii. p. 927 of his *Pathological Anatomy*, says he has never seen the corn penetrate the subjacent articulation.

The progress of corns, the pain they occasion, and their ultimate result, differ with the varying intensity of their exciting cause, and with the different plans of treatment adopted for their cure. Thus, excessive irritation from pressure or other causes may excite inflammation and suppuration in the cellular tissue or bursa which often lies beneath. The matter in these cases generally finds exit by bursting, the thickened epithelium may scale off, and a cure result; or the matter, before bursting externally, may find its way into one of the phalangeal joints, giving rise to a small but troublesome perforation of the articulation. Occasionally the suppuration of a corn, its bursting, and the consequent exposure of the deeper parts, will lead to loss of one of the phalanges by necrosis. Some time since there was in the wards of St. Bartholomew's Hospital a patient who, from a perforating ulcer originating in a corn, had lost by necrosis the first phalanx of the little toe, together with the distal end of the corresponding metatarsal bone.

Treatment, when not followed by cure, may modify the progress of the disease, by exciting in some cases inflammation, ulceration, or sloughing of the part; such effects being for the most part caused by the application of various escharotics. The ordinary practice of chiropodists—namely, that of cutting out the centre of the corn deeply, leaving the circumferential part, and protecting the centre from pressure by properly adapted plasters—often produces a change in the structural arrangement of the growth. Thus, the central hole may become filled up by what is termed a fibrous corn; *i.e.* a corn with a vertical arrangement of its epithelium, which ensheathes a few elongated and sensitive papillæ. By maceration the two parts of the corn may easily be separated; the vertical or fibrous portion coming out like a plug, and leaving a clean hole in the surrounding laminated and thickened epithelium. Another effect of frequent cutting is the permanent depression of the centre of the corn considerably below the level of the surrounding skin, and coincidently with this change there is absorption of the cutaneous papillæ.

The common pearly yellow hue of corns is due to simple condensation of the epithelium. Occasionally minute hæmorrhages take place into their substance, either from some unusual irritation of the cutaneous papillæ, or by injury to their extremities by cutting, or in attempts to extract the corn. The centre of the growth may thus acquire a bluish-black tint, popularly supposed to be the root of the corn, and upon the extraction of which the profeſsed corncutter specially prides himself.

Fibrous corns.—These might more properly be called warts, since in them the papillary structure of the skin predominates. They consist generally of a few elongated papillæ ensheathed by epithelium, rough on the surface, and more sensitive to pressure than the ordinary corn. They are situated for the most part on the balls of the toes or soles of the foot, rather than on the dorsal aspects of the phalanges; nor have they, in such specimens as the writer has examined, any underlying bursa.

Soft corns are found generally between the toes, and most frequently upon the fourth toe, on one or other of its lateral aspects. They differ from hard corns in being more sensitive and vascular, in the greater rapidity of their growth, and in many of them possessing a pretty distinctly papillary structure. The constant moisture to which they are exposed from their position causes them to become spongy and condylomatous in their appearance. Indeed, many that pass under the name of soft corns upon the feet would, if found in the neighbourhood of the anus, be recognised as condylomata. Not a few have broadly overhanging edges overlying the sound skin around, seemingly the effect of pressure upon their soft and spongy texture. Occasionally a bursa is found beneath them.

These corns are liable to the same accidents as the harder variety; they may inflame, ulcerate, or suppuration may take place in the bursa or subcutaneous tissue beneath them, giving rise generally to a minute central aperture through which a serous fluid oozes for long after the escape of the matter.

In addition to the ordinary and most obvious inconvenience attached to corns, namely, pain, increased by warm or moist weather, and generally most annoying during the spring-time, there are the more serious evils of suppuration and ulceration; the latter being generally a sequence of the former, or in some cases resulting from the indiscreet application of caustic irritants to the corn. In patients with languid or deficient circulation, where, either from want of power in the heart or from disease of the arteries of the limb, the standard of nutrition is too low to resist the ulcerative process, the ulcer may form the starting-point of a slowly progressive gangrene.

Less obviously, though not less certainly connected with these growths, are many cases of lateral curvature of the spine; generally commencing in early life, and taking their origin from a habit of throwing the weight of the body in walking to one side, in order to relieve the pain of a corn on the opposite foot. Among the same class are rare instances of cramped and difficult action of the muscles of the leg and foot, which may excite suspicions of a failure in the nervous energy of the patient, but are really due to the habitually constrained movement of the limb in the attempt to 'favour' a painful corn.

Treatment.—*Hard corns* in their earliest stage will often disappear if the irritation that produced them be removed, and this may generally be traced to the wearing loose, ill-fitting, or patent-leather boots, or it may be simply to the habit of wearing the same boots many days in succession. The application of a drop or two of glacial acetic acid with a camel-hair brush every night will disorganise the cuticle, which may then be picked off with the point of a knife or scissors, or the corn may be rubbed down with a corn-file. The cuticle may be softened for rubbing down by the application of lint steeped in a solution of carbonate of soda, and covered with oiled silk. It is well, after the removal of a corn in the foregoing manner, to protect the part for a time by wearing over it a small patch of soap plaster spread on wash-leather.

When, from a day of unusual exertion, or from any other cause, a corn becomes inflamed or more than ordinarily painful, it may be covered at night-time with a small patch of wet lint with oiled silk over it; this both relieves the pain and gives an opportunity in the morning for removing the growth entirely.

The use of nitrate of silver in substance is strongly recommended by some surgeons; it should be applied after the thickened epithelium has been pared down, or, better, picked off; the scale of blackened cuticle which it produces is said to separate in a few days, leaving a smooth and healthy surface, if the corn has not penetrated too deeply. Some discretion must be exercised both as to the condition of the corn (whether inflamed or otherwise), and as to the extent to which this remedy is applied; its injudicious use may produce considerable suffering.

Old-established hard corns are seldom cured, since the patient is unwilling to submit to the restraint and inconvenience of the necessary treatment. Occasionally an illness which confines the sufferer to bed for some time rids him of his corns, or they may disappear in the desquamation following scarlatina.

It is notorious that, as the expression is, those who 'attend to their corns' suffer but little inconvenience from them; while among those who suffer most are such as visit chiropodists at prolonged intervals and purchase for themselves a few weeks of ease at the cost of as many more of suffering. In the treatment of old-established hard corns it may be well first to soften the cuticle by the application of wet lint and oiled silk during some hours; when it is soft and pulpy an incision may be made with a small sharp knife completely surrounding the centre of the growth, or the same incision may be effected with a succession of snips with the points of a pair of scissors. Having completely circumscribed the corn, its centre may be raised with a fine hook or a pair of forceps, and the included piece may be removed by cutting under its base; each incision being of small extent, or it will cause pain. The margins of the opening left by the removal of the corn may be slightly bevelled off, and a plaster applied made of soft thick buckskin or amadou spread with adhesive material; a hole being cut in the plaster corresponding with the extent of the corn, and the outside margins of the plaster being bevelled off with a sharp knife.

If it be thought sufficient to protect the corn from pressure without previously removing any of its substance, the centre of the growth may (as recommended by Sir B. Brodie) be covered with a piece of linen rag or thin diachylon to prevent it bulging through the hole in the corn-plaster.

Suppuration beneath a corn may be recognised by the intense pain and throbbing of the part; it should be relieved as soon as possible by puncture, the cuticle being previously softened by the application of warm-water dressing. In favourable cases where the circulation in the foot is healthy and vigorous, the opening of an abscess beneath a corn is frequently followed by complete disappearance of the growth; in others, either from general debility or local deficiency in the circulation, this perforation gives rise to a chronic and intractable form of ulcer. Such a sore is best treated by invigorating constitutional remedies; and among these, opium in small doses is generally most effective; locally some stimulating application, such as resin-cerate or turpentine-ointment, may be used with advantage.

Soft corns seem to owe their existence to the friction of one toe against its neighbour, and their more rapid growth to the warmth and moisture of the locality where they are for the most part found. Unless in a state of inflammation, these corns may generally be cured by the application of the oxide of zinc in powder, or equal parts of this and the pulvis æruginis may be dusted over the growth, and the toe be surrounded with a thin wrapping of cotton-wool; after a few applications the corn will either dry up and disappear of itself, or its shrivelled remains may be cut away without pain or inconvenience. The application of the glacial acetic acid will be found very useful in the treatment of soft corns. But whatever plan be adopted for the cure of the disease, the affected toe should be kept apart from the others by the daily application of cotton-wool.

There are certain corns which, from their situation and cause, require a separate mode of treatment; such are those arising from contraction of the flexor tendons, with doubling-under of the ends of the toes and unnatural prominence of the phalangeal joints on their dorsal aspect. The corns from this cause are situated either on the extremity of the toe or on one of the joints on the dorsal surface. In these cases the toes must be straightened, either by strapping the toe or toes to a gutta-percha splint placed on the plantar surface, by division of the flexor tendon, or by winding a piece of linen rag or adhesive plaster over the dorsum of the prominent toe and beneath the toes on either side.

Those whose feet are habitually predisposed to corns, or who suffer serious inconvenience either from the number or pain of these growths, should wear boots made from some other material than leather. As a substitute for leather nothing is so good as the invention that rejoices in the classical but ungrammatical name of *pannus corium*. This, from its softness and pliability, is particularly suited to tender and irritable feet. Persons liable to corns should carefully avoid wearing patent-leather boots, as hindering the escape of the cutaneous transpiration.

BUNIONS.

The term 'bunion' is applied to enlarged bursæ situated on any part of the tarsus, metatarsus, or phalanges of the toes; but for the most part placed over the metatarsal joint of either the first or fifth toe, and accompanied with more or less distorsion of the subjacent articulation.

To study rightly the exciting cause of this disease, it may be well to revert for a moment to the natural form of the foot uninfluenced by the distortion produced by modern boots and shoes. Perfectly formed feet may be seen in the many shoeless children of the London streets. If such be examined, it will be found that, as regards general conformation, the foot is widely spread towards the toes, that the inner line of the foot and great toe is nearly straight, or as Professor H. Meyer more accurately expresses it,* the central longitudinal axis of the great toe carried backwards passes through the centre of the heel. There should be moreover a considerable interval between the first and second toes along the whole of their contiguous margins; the second and third toes are also separated, though by a narrower interval; nor do the third and fourth toes touch each other when the weight of the body is borne on the foot.

Comparing with this the foot of an adult that has been distorted by the purely conventional shape of modern boots or shoes, we may observe, first, that, from lateral pressure and crowding, all the toes are in close contact with each other, and not infrequently the second or third toe overrides or is doubled under its neighbours, or the little toe is doubled under the fourth toe so that on the dorsal aspect of the foot its root is but just visible. From the same cause the toes all incline towards the middle line of the foot; this distortion particularly affecting the great toe, which, instead of remaining in a right line with its own metatarsal bone, turns obliquely away towards the outer side of the foot; so that if the line of its longitudinal axis be carried backwards, it would fall altogether to the inner side of the heel.

The above-mentioned distortions are easily accounted for by the narrowness of the sole of modern boots, which crushes up the toes into a bunch; and the sloping of the inner side of the boot towards the middle line of the foot, thus constantly exercising pressure on the inner side of the great toe and thrusting it over towards the outer side of the foot. Boots again very generally by their shortness press on the end of the same toe, pushing it directly backwards, thereby increasing its distortion from the right line, and this, by bearing on the head of the corresponding metatarsal bone, causes the latter to project on the inner side of the foot. In addition to the direct effect produced by the pressure of misshapen boots, the material of which the boot is made may exercise a predisposing influence on the formation of bunion; patent-leather, as it is called, or any material which, like it, completely stops the evaporation of the transpiration from the cutaneous surface, has this effect.

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* 'Procrustes ante portas,' by H. Meyer, translated by J. S. Craig, Edinburgh.

There exists undoubtedly in many persons an hereditary tendency to the formation of bunions, a predisposition in which even the most carefully constructed boots will fail in averting the formation of these cysts.

Though generally situated over the first joint of the great toe, as the part exposed to greatest irritation, yet it is by no means rare to find bunions developed over the prominence of the scaphoid bone, or again on the outer side of the foot over the proximal or distal end of the fifth metatarsal bone, and elsewhere on the dorsum of the foot over any bony prominences where the natural conformation of the part fails to correspond with the artificial and arbitrary shape of the shoe.*

In its early formation, a bunion generally attracts attention as a painful and tender spot over one of the metatarso-phalangeal joints previously exposed to pressure and irritation by distortion of the corresponding toe. By-and-by, the part enlarges, indicating an effusion into an already existing bursa,† or the formation of an adventitious synovial cyst. This effusion, though the result of inflammation, is generally recognised as designed to protect the subjacent parts from pressure. At this point the disease may cease to make progress; the bursa may remain; and may effect the object to which we have just alluded, occasionally reminding the possessor of its existence by a passing twinge of pain. Far more frequently the bursa, though an efficient protection, reserves to itself the irritation it wards off from the joint beneath; the consequences of this are seen in repeated attacks of pain or inflammation, causing progressive enlargement; or it may be in the formation of callosities or corns on its surface, or in suppuration of the contents of the cyst. The evacuation of the fluid from the interior may be followed by obliteration of the cavity and cure of the disease; but in old people, or in those of languid circulation, it may give rise to a most troublesome form of ulcer.

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* Through the kindness of Mr. E. James, of the Melbourne Hospital, we are enabled to quote the following remarks of Dr. George Bennet, of Sydney, in answer to an inquiry by the writer of this article:

'*Sydney, March* 1861.

'With respect to the distortion of the feet of the natives of this country, I have observed neither in the aborigines of Australia, nor among the natives of the Polynesian Islands I have visited, any of the distortions you allude to as seen on the feet of the civilised races who encase them in shoe-leather. Nor have I seen among the natives corns or bunions.'

† For an exhaustive enumeration of natural bursæ, vide Schreger, *De Bursis mucosis subcutaneis.*

The perforating ulcer of a bunion has for the most part a pallid indolent appearance, and secretes a pretty abundant sero-purulent discharge. If a probe be introduced, it will generally be found that the size of the external orifice bears no proportion to the cavity of the sore, which latter is relatively very large, and extends some distance beneath the margins of the ulcer: occasionally there is a fistulous passage from the bottom of the sore communicating with the joint beneath.*

Coincidently with the distortion of the joint, which precedes or accompanies the formation of a bunion over the base of the great toe, there are changes to be observed in the conformation of the articular ends of the bones, in the cartilage, ligaments, and tendons, in connection with the joint. The head of the metatarsal bone enlarges, and is often encircled at its margin by bony deposits; the articular cartilage is almost invariably absorbed, and the bone beneath eburnated. The internal lateral ligament is elongated; and the external so shortened that, if in the dead body an attempt be made to restore the toe to its natural position, this ligament tears. The extensor tendon of the great toe is dislocated to the outer side to a greater or less extent, and in extreme cases the sesamoid bones will be found to have shared in the general displacement, being dislocated with the phalanges of the toes towards the outer side of the foot.

It may be questioned whether these changes in the joint, which are analogous to those occasioned by chronic rheumatic arthritis, are directly the effect of the distortion, or whether they are not rather occasioned by that disease occurring in the joint in question as the 'locus minoris resistentiæ,' as it has been called. This is the more probable from the known tendency of gout to attack the same joint, and it may be for the same reason.

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* This affection is the 'mal perforant du pied' of French authors.

Treatment.—It is only in the early stage of bunion that treatment will avail for the complete removal of the disease, though palliative measures are practicable at all times.

The tender spot that precedes the formation of a bunion may be advantageously covered by night with wet lint and oiled silk, while by day a more commodious boot than usual should be worn to free the part from pressure, care being taken that the boot or shoe be wide in the sole, and not sloped off on the inner side towards the median line of the foot. If the part be very tender, it may be covered during the day with soap-plaster spread upon kid or wash-leather.

So soon as a cyst has formed, in addition to the above-mentioned precautions, means should be taken to procure the absorption of its contents, either by the occasional application of strong tincture of iodine, or the continual application of the compound mercurial cerate upon linen rag, the margins of the swelling being protected with some soft plaster. For the cure of bunions when uninflamed, and for such as have much fluid within them, we have found an ointment of biniodide of mercury most useful; it should be applied occasionally, or at least not so constantly as to blister the skin. The strength we would recommend for this purpose is ten grains of the salt to an ounce of lard.

On the occurrence of inflammation in the sac of a bunion from any cause, water-dressing, or a poultice, will be found the most comfortable application. A careful watch should be kept for any sign of suppuration, since, should it occur, an early and free incision is both requisite for the relief of pain, and is often followed by the complete cure of the disease. It is often the habit of persons suffering from severe bunion and distortion of the toes, to wear boots made to fit accurately their distorted feet. Professor Meyer recommends in such cases the wearing of a shoe so constructed as to tend to restore the toes to their natural position. He says, 'the sole should be cut exactly as if the toe were in its proper position;' questioning, however —and we think with reason—how far such an expedient would be advisable in cases of very extreme distortion of the joints, or prominence of the enlarged bursæ.

The difficulty of healing the ulcer resulting from the bursting of a bunion is sometimes very great, especially in old people, or in those whose circulation is languid from other causes. A stimulant local application, such as the resin or turpentine-cerate, will generally be found useful; while the use of opium and stimulants internally, with easily assimilable and nutritious diet, is called for. If, as is generally the case, the ulcer have a small external orifice and deeply undermined and over-hanging edges, they should either be destroyed by caustic, or they may be laid open by a crucial incision, or be removed entirely by scissors. Under the most judicious treatment, however, these ulcers, in persons of feeble circulatory powers, or where the arteries of the part are extensively diseased, may form the starting-point for senile gangrene.

WARTS.

Warts or verrucæ, are collections of overgrown cutaneous papillæ, either completely ensheathed by an excessive formation of scaly epithelium, or each papilla of the growth stands beside its fellow, separate, having only its natural cuticular sheath.

Verruca simplex, the most common form of wart, consists of a bundle of hypertrophied papillæ, closely adherent, and ensheathed by a thick covering of cuticle: from friction and exposure to the air its surface is generally horny in texture, and is rounded off into a small button-like protuberance. This species of wart is found solitary or in large numbers, chiefly in young persons, and is situated most usually about the hands or fingers, occasionally on the face, and more rarely on other parts of the body.*

Verruca digitata is a name applied to a less common variety of wart, situated almost invariably on the hairy scalp. On examination, it will be found to be formed of a few cutaneous papillæ imperfectly ensheathed by cuticle. This wart is more pedunculated in its attachment to the surface than the foregoing variety; its papillæ are long, and often free at their extremities, giving the surface of the growth a ragged appearance. It is found, as stated above, generally on the scalp, and so far as one's own experience extends, only in women after adult age: such warts, either from their number or from some unfortunate peculiarity in the position of a single growth, may give rise to great pain and inconvenience in brushing or combing the hair.

Subungual warts.—Warts very similar in structure to the foregoing occasionally form beneath or at the side of the finger or toe nails. Situated here, they are generally softer in texture and more rapid in growth than those on the scalp. They originate beneath the nail from the sensitive skin to which the nail is attached, between its free margin and the *real* matrix; and in their further growth they generally crop out either at the free extremity or lateral margin of the nail. Such are apt to be very painful and inconvenient.

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* A case is related of a wart of this kind occurring on the tongue, *Medical Times and Gazette,* 1861, p. 556.

Verruca confluens is a term introduced by Mr. Erasmus Wilson to designate a variety of warts found on various parts of the body, chiefly over the neck and upper part of the thorax, or the backs of the hands or arms. The growth in question consists of an aggregation of closely packed but distinct papillæ, often smooth on its surface, and without any evident indication of the isolation of its component papillæ; but on pinching up the skin of the part its surface will break up into minute fissures showing its papillary structure, which bears a resemblance, in M. Rayer's opinion, to coarse plush.

These growths are of uncertain size and shape; they may occur in patches or irregular bands. Either spontaneously, or more generally under some local irritation, they may extend pretty rapidly over the surrounding skin; their advance in any direction being usually preceded by the enlargement, here and there, of outlying and isolated cutaneous papillæ.

Differing in some respects from ordinary warts are those of venereal origin. Such are more vascular in their structure, are often of fleshy consistence, and pedunculated in their attachment to the surface. If those that have existed some time be examined microscopically, their bases will be found to include portions of the structure of the deeper layers of the skin; namely, a dense network of areolar tissue and more thinly scattered elastic fibres: in this particular they resemble old condylomata, and in this they differ from common warts, which consist only of papillæ and their epithelial covering. Venereal warts often have comparatively large blood-vessels entering their under surface. Such warts, from the warmth and moisture of their position, situated (as they usually are) beneath the foreskin or between the labia, grow more rapidly, and attain a larger size than other varieties, propagating themselves abundantly by contact with neighbouring parts.*

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* We have seen in a child warts precisely similar in appearance to the venereal, growing from the commissure of the lips, and lying within them when the mouth was closed.

Causes.—Though occasionally congenital in their origin, warts are notoriously capricious in their appearance, period of duration, and disappearance. Some individuals exhibit an hereditary tendency to their formation, and not a few are affected with warts corresponding in position exactly to those existing in one of their parents.

Mr. Sedgwick gives an account of a family under his observation, where warts on the hands have been hereditarily limited to the female line for two generations. The mother herself was much troubled with numerous warts on her hands, which appeared in infancy, continued through childhood, and disappeared soon after puberty. She had five children: a boy aged eleven, a girl aged nine, a girl aged seven, a boy aged five, and a girl aged two and a half: the two boys never had a wart; the three girls are all troubled with them—the eldest has thirty warts, the next daughter has twenty-four on the hands. In both, the warts appeared in infancy, and have increased in number since. The youngest child has two warts at present.*

The period of life between infancy and puberty seems particularly that in which warts grow most luxuriantly. Verrucæ may suddenly appear either singly or in large numbers; such eruptions generally attacking the hands and wrists; they may remain a longer or shorter time, and as rapidly and unaccountably clear off.

Adults but rarely suffer in this way, though we recently observed a very copious eruption of warts over one side of the neck and upper part of the chest in a lady about forty years of age. They were very numerous, and a few weeks had elapsed since she noticed their commencement; they varied greatly in size, some being but just visible, while others were as large as swan-shot. More recently a professional friend showed me a large crop of common warts of various sizes, which had appeared without apparent cause upon his own hands, none of them having existed more than four or five weeks.

The irritation produced by certain discharges, especially by such as are of venereal origin, is a well-known and generally acknowledged cause of one form of wart; and no less certain is the occasional effect of soot in the production of the malignant wart of chimney-sweepers.

From the frequent occurrence of distinct warts, or warty thickenings, upon the hands of persons occupied in post-mortem investigations, or in the study of practical anatomy, it is more than probable that the poison of decomposing animal matter, under certain conditions, is capable of exciting the formation of these growths. At all events, one's personal experience, and that of many of our pathologists and demonstrators of anatomy lends support to this opinion.

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* *Brit. and For. Med.-Chir. Rev.* April 1863.

Some warts are undoubtedly contagious, and especially those of venereal origin, and such as occur from other causes about the genital organs; next to these in their aptitude to spread by contact are such as occur in crops about the hands.

It is a popular belief that the blood from a wart is capable of reproducing others when applied to the external surface of the body; and a case has recently appeared in the French journals tending to confirm the popular prejudice. M. Cruveilhier states that M. Banuel showed him a band of warts upon the back of the hand, assuring him that they had sprung up in the line of the stream of blood flowing from one of these growths during its removal.* But M. Rayer states that 'he has repeatedly tried to inoculate warts in this manner; but the operation has never succeeded.'† Unintentionally one has several times performed the same experiment, and always with a negative result.‡ As one would suppose, such warts as furnish a secretion from their surface, manifest most decidedly their contagious character; but that this peculiarity is not confined to such, I may refer to a case related to me by Mr. Paget, where an individual with a small and completely dry wart on the foreskin, which had existed for some years, and who had suffered from no venereal affection within many years, married, and communicated to his wife a most abundant crop of warts, which affected the labia and parts about. She in the mean time suffered from no discharge, either leucorrhœal or gonorrhœal. The original wart in the husband underwent no change either in size or appearance, nor did it furnish any palpable secretion.

Progress.—The capricious and sudden disappearance of warts has given rise to a belief in the efficacy of charms for their removal. But it is rare for any but the common wart that affects the hands of young people to disappear in this way; and this may account for the fact that wart-charms have but little reputation for the cure of these growths when of venereal origin.

The common wart of the external integument may remain for many years, or a lifetime, without materially increasing in size; its growth, however, may be stimulated by some permanent source of local irritation; indeed, warts that in their commencement differ in no recognisable feature from the verruca simplex, may in their subsequent progress assume a character in no way distinguishable from epithelial carcinoma; such are usually situated on the face. For an interesting and detailed account of the structural changes occurring in their degenerations, the reader is referred to a paper by Dr. Collis in the *Dublin Quarterly Journal* for May 1860.

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* *Anatomie path. générale*, tom. iii. p. 926.

† Rayer, *On Diseases of the Skin*, p. 982.

‡ I am acquainted with a gentleman who intentionally performed the same experiment, and with apparent success; a wart forming on the back of the hand where the blood was applied.

The production of horns by the excessive growth of warts, with the dessication of their external layers of cuticle, will be considered under the head of 'Horns.'

Treatment.—Warts that are dry in their texture and but scantily supplied with blood, such as the verruca simplex and the scalp-wart, may generally be easily removed by some chemical solvent; perhaps one of the most efficacious and manageable of these is the glacial acetic acid; it also has the advantage of being painless in its action. It may be applied with a camel-hair brush to the wart until its texture is pretty thoroughly sodden with the acid, care being taken to prevent the blistering of the skin in the neighbourhood; the application may have to be repeated once or twice. Nitrate of silver in substance is a popular but unsightly remedy. Tincture of the perchloride of iron is generally effectual, but is better suited for the cure of warts that are moist and secreting. The application of a drop of the strong nitric acid, or acid nitrate of mercury, is exceedingly efficacious, and causes less pain than is generally supposed.

Vascular pedunculated warts of venereal origin may be removed at once by the knife or curved scissors; or if too vascular or bulky for this remedy, the application of some drying powder, such as the oxide of zinc, or equal parts of this and the diacetate of copper, or a mixture of equal parts of powdered savine and diacetate of copper: any of these constantly applied will either remove the growths entirely, or bring them into such a condition that they may be safely removed by the knife. Some discretion must be exercised in applying the knife to large crops of warts of long standing or considerable size, situated upon either the glans penis or internal labia, as troublesome or even dangerous hæmorrhage may occur; of this, examples not infrequently occur in the venereal wards of our hospitals. In my own experience I have been compelled on one occasion to apply the actual cautery to the glans penis to arrest the hæmorrhage caused by the removal of a mass of verrucous growths; the bleeding in this case was most formidable in quantity, and quite uncontrollable by other means used for its suppression. In many cases of very bulky pedunculated and vascular warty masses, such as affect the external genitals of women, and more rarely those of men, the écraseur of Chassaignac will be found a convenient and safe instrument for removing the disease. The warty thickenings that occur on the hands from the contact of post-mortem fluids may be treated by the free application of the acid nitrate of mercury, or they will slowly disappear if protected from friction. An ingenious method has been devised by the late Mr. Nesbitt, of Wolverhampton, for the removal of pedunculated warts by the application of an elastic ligature. A thin india-rubber thread, such as may be drawn out from an old brace, or a small elastic ring, is applied to the base of the growth, so as to constrict it pretty tightly, though not painfully. In a few days the wart will generally dry up and fall off.

For the cure of congenital warty growths which affect large portions of the skin, and for those described under the term 'verruca confluens,' the free application of the strong nitric acid is necessary; or the growth, if small, may be excised with the portion of skin upon which it is based. Occasionally it is advisable, in order to avoid loss of the integument, to shave off the papillæ composing the wart with a sharp knife, and to brush the surface over lightly with nitric acid.

The most effectual and speedy cure of warts is by excision of the growth itself, together with the integument upon which it grows; and this is the safest manner of treatment for rapidly growing or degenerating growths, or any which excite a suspicion of a malignant character.

From the situation of subungual warts upon the fingers or toes it is difficult to apply caustics, or to remove the disease by excision; where this is the case, the papillæ composing the growth may be pulled out separately by means of the forceps—a proceeding easy of execution, and causing but little pain.

Horns.

Differing but little in their elementary composition from warts, horns, by their different structural arrangement, and by the greater exuberance of their growth, present but little external resemblance to these growths. True horns consist of scaly epithelium, more or less condensed and dessicated, for the most part containing within them a fibrous-looking papillary core derived from the true skin, and consisting of extremely hypertrophied papillæ, each thickly ensheathed and separated from its fellow by a condensed cuticular covering. These are supplied freely at their base with blood-vessels, which penetrate some distance up the centre of each. They form the matrix from which layers of cuticle are continually being formed and pushed onwards.* Such horns may be called 'papillary.' They are marked externally by longitudinal lines, are rough and fibrous-looking, and generally taper towards their ends, their free extremity being often finely pointed. As might be supposed from the large growing surface presented by the papillary core, these horns are often very rapid in their growth, and attain to a larger size than any other variety. They grow generally from the free surface of the skin, being immediately connected with it.

Another type upon which horns are formed is where they grow from a vascular matrix, flat, or very slightly projecting beyond the level of the skin, and sending no prolongations into the interior of the horn itself, which in this case is formed entirely of epidermis in various stages of condensation. These horns are generally marked by annular constrictions at pretty regular intervals; they have a tendency to curve or become spiral, and bear, for the most part, a greater resemblance to the horns of the smaller ruminants than the papillary variety.

These horns, moreover, from the more horizontal lamination of their component parts, more readily break off and more easily crack transversely; while the papillary horns, from their fibrous arrangement, split longitudinally at their extremities, but break off with difficulty. Perhaps the best examples of the former description of horn are met with growing from the matrix of the toe-nails, or from the interior of sebaceous cysts, where, indeed, they attain their largest dimensions.†

There is in the Museum of the Royal College of Surgeons an anomalous specimen of a horn formed of compact bone, ensheathed by a covering of horny matter; the bone within the horn apparently has no continuity of tissue with the skull. The parentage of this growth seems to be uncertain, since it is described in the catalogue as '*supposed* to be an excrescence from a human scalp.' Bony projections from the exterior of the skull, having the external appearance of horns, but being connected with the bones of the skull, are not true horns but exostoses, and are generally of the variety termed 'ivory.'

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* For a good description of the minute structure of these horns, see a paper on human horns by Mr. A. M. Edwards, *Edin. Med. Journal,* November 1859.

† For an excellent description of the structure and manner of growth of this variety of horn, the reader is referred to Mr. Erasmus Wilson's work on *Diseases of the Skin,* p. 621.

From tabulated accounts of cases of horny growths,* it appears that out of 151 cases, 81 occurred in females, and 70 in the opposite sex. From the same tables one may gather the comparative liability of certain regions of the body to these growths. Thus, of 142 cases, 63 grew from the head; 32 from some part of the lower limb; 23 from the trunk, on one or other of its aspects; 16 from the face; and 8 from the glans penis. In addition to these, we may take into consideration horns growing from the toe-nails, which are by no means rare among those old women of the poorer classes who jealously guard their feet from the contact of water.

Origin of horns.—A generally acknowledged and common source of human horns is from the interior of sebaceous cysts, such as frequently affect the hairy scalp. They may arise from the interior of an unruptured cyst, and bursting through the cyst-wall may continue their growth external to it; but far more frequently the horn takes its origin from the secreting surface of a cyst that has either burst spontaneously or been accidentally ruptured. Such may grow with extreme rapidity, the exposure to the external air having the double effect of stimulating the increased secretion of epithelial matter, and of rapidly drying that already formed to a horny consistence.

A growth, differing in its structure in no material particular from the horns of sebaceous origin, is often found growing from the matrix of one of the toe-nails, being most frequently situated on the great toe. They may be found from one to four inches in length, tapering at the point, and often curved spirally like a ram's-horn. In these growths, the layers of epithelium forming the nail, instead of lying, as is natural, parallel to the long axis of the phalanx, lose their horizontal arrangement, and becoming more vertical, turn upwards as they are pushed forwards from below by the growing matrix.† The exterior of these horns is dense and partially translucent, having the appearance and consistence of horn; the interior is composed of epithelium, less condensed, and easily separable into layers. Cruveilhier considers that the pressure of the bed-clothes in old and bed-ridden people gives rise to these growths by irritating the matrix of the nail. The best specimens that I have seen of this form of horn have been among old women who have presented themselves as out-patients, in whom, therefore, this cause could not have been in operation. Moreover, it may be generally observed that these horns turn outwards, lying over the tops of the other toes, their direction being influenced by the shape and dimensions of the shoe.

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* Erasmus Wilson's *Diseases of the Skin*, p. 624; where also is a reference to a paper by M. Lozes in *Mém. de l'Académie royale de Médecine*, June 1830.

† A good example of such a growth is seen in St. Bartholomew's Hospital Museum, series xxvii. species 24.

The papillary horns, as they are called, in their commencement differ but little from some of the dry kinds of wart; indeed, it is more than likely that many of these growths are of warty origin. Mr. Erasmus Wilson denies the possibility of this mode of origin, in opposition to Cruveilhier.

In the College of Surgeons Museum is a specimen 'of a horny growth from a wart on the hand.' It is about three inches or more in length, about an inch in diameter at its base, and has a longitudinally fibrous structure; it is an undoubted horn. I myself removed a small horn, about half an inch in length, attached to the integument of the neck, from a woman in whom I had the opportunity of watching its origin in the form of a small wart.

Horns are occasionally found in connection with epithelial cancer, and generally grow from the thickened and tuberculated skin at the margin of the cancerous ulcer. Cruveilhier cites a case of this kind connected with the lower lip. A patient presented himself at St. Bartholomew's Hospital with a recurrent epithelial cancer of the heel, connected with which was a horny growth in the form of a large flat boss, which on removal proved to be true horn.* Analogous to horny formations of this kind are such as are occasionally met with in the keloid disease of cicatrices, and in chimney-sweeps, connected with cancerous warts.

Treatment.—The only efficient treatment for these growths is by complete removal, together with the portion of the skin upon which they are based; or if springing from the interior of a sebaceous cyst, the whole of the cyst should be dissected out. Such as grow from the matrix of the toe-nails are best removed by a fine saw, if too dense for the knife; the nail being subsequently pared away to its proper shape and dimensions. Any subsequent tendency to exuberant growth from the same part can be checked by the application of the glacial acetic acid, which possesses the property of dissolving epithelial structures.

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* A case is related by Mr. Hutchinson in the *Pathological Transactions* for 1857, of a horn growing from the angle of the mouth; the base of this eventually became the seat of a papillary epithelial cancer.

Boils.

Furunculus, or boil, is a circumscribed inflammation of the skin and subcutaneous areolar tissue, attended by a local effusion of lymph, and followed by the death of the central portion of the involved tissue; and this, the core, is subsequently expelled through an opening in the cutis, together with the degenerated products of the inflammatory process.

Among minor differences, which are chiefly those of degree, one may distinguish pretty clearly between such boils as are lumpy, definite in extent, and prominent on the surface, and such as are flat and less defined in their outline.

(*a*) *The ordinary boil.*—The former of these varieties generally commences as a lump beneath the skin; at first perhaps but little sensitive; this as it increases in size seems to irritate the surrounding tissues, producing pain and heat about the parts; at the same time, the external swelling becomes more pointedly conical, and acquires a bright-red blush on the surface. The pain is now more considerable, and is of a piercing, throbbing character, occasionally varied by a distressing sensation of tension and weight at the part affected, the surface of which is now exquisitely sensitive to the slightest external irritation. It is probable, as has been suggested, that the sloughing process is during this time extending through the dense structure of the true skin; since before long a purulent spot appears at the apex of the swelling, and coincidently the local suffering is considerably diminished. This pustule, or vesicle, after a slight increase in size, bursts, and gives exit to a little sanious pus, and discloses a narrow opening leading straight through the cutis, to a greenish-yellow slough beneath. After a variable interval, the slough becomes loosened, and presents itself at the cutaneous orifice, which appears far too small for its convenient exit; through this, however, it makes its way—a small shreddy wad of dead tissue, soaked in inflammatory products. The subsequent progress towards recovery is rapid; the flask-shaped bed of the boil for a day or two discharges some sanious shreddy pus; then quickly fills up with granulations, and cicatrisation takes place, leaving behind a small, depressed, and slightly-discoloured spot.

Boils are considered by some to be confined to the true skin, and not to affect the subcutaneous tissue; the core, or slough, is also said to be almost entirely composed of inflammatory products.* In this opinion we cannot coincide. The slough, or core, if examined microscopically, will be found to consist of the elastic and fibrous elements of the deeper layers of the true skin, matted together by lymph in various stages of disintegration.

(*b*) *The flat, more diffuse,* or, as it is termed, the 'blind' boil, generally commences in a small inflamed pimple, surrounded by a red and exquisitely tender areola, ill defined in its margins. The pain of such a boil is from the first of a throbbing nature, keeping time with the pulsation of the heart, and is greatly increased in severity by any excitement of the circulation, such, for instance, as follows the administration of any diffusible stimulant.

The pimple in the centre of this form of boil either very slowly pustulates, or, more generally, forms a vesicle containing blood-stained serum; and on the giving way of the cuticle, this is discharged with a little shreddy sanious pus, and with far less solid slough than separates from a common boil. The blind boil also, so far as our own observation extends, seems to belong to a more atonic and debilitated state of system than the ordinary lumpy boil. Occasionally boils spontaneously disappear without proceeding to suppuration; such are generally slow in their formation, and cause but little pain.

For the most part, the progress of a boil is not attended by any constitutional fever, nor is their eruption preceded by any distinctive premonitory symptom; yet not infrequently individuals who have had much experience of boils in their own persons can anticipate the appearance of each fresh visitor by the occurrence of a certain feeling of general discomfort and chilliness, while in others the eruption is preceded by a transient irritability and querulousness of temper.

Boils may be stated to be in almost every case local manifestations of certain constitutional conditions. It is usual in treating of analogous affections, first to treat of the general causes and symptoms which produce and precede the local malady. But since no distinctive group of general symptoms can be pointed out as indicative of an approaching eruption of boils, we have ventured to reverse the order commonly observed in the systematic description of disease, and shall proceed from the description of the characteristic and constant symptoms of the local malady to the consideration of the less definitely marked conditions of the constitution at large, which precede and apparently occasion the eruption. We adopt this course, hoping thereby to eliminate some rational indications of treatment, not so much for the boil itself, as for the conditions of the system that determine its appearance.

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* A clinical lecture by Mr. Syme, *Lancet,* March 8, 1856, p. 269. Rokitansky makes the same statement, *Path. Anatomy,* vol. iii. p. 85.

Among the causes of boils, it is generally recognised that certain atmospheric conditions largely influence the predisposition of the population at large to this disorder. Thus, as a matter of certainty, we know them to be more prevalent during the spring and early summer than in the autumn and winter. Again, during certain years boils have prevailed in this country epidemically; they did so in the years 1851, 1857, and 1858, when their appearance could not be connected with any unusual atmospheric condition of which we have any cognisance. There are, however, certain conditions of the system which exercise a definite influence in the production of boils; such a condition is induced in the majority of patients under the hydropathic treatment, as it is called. Here an alteration in the patient's diet (for the most part in the direction of greater simplicity), the diminution or deprivation of stimulants, copious draughts of water, a greatly increased secretion from the skin and kidneys, will sooner or later almost unfailingly produce a general eruption of boils.

Again, a constitutional condition highly predisposing to boils is induced in those who subject themselves to the training process which prize-fighters and athletes undergo, and which is necessary for those who row in races. The general experience of persons in the better classes of society seems to be, that the more out of condition they are when the training process is commenced, and the harder they train (as the expression is), the more liable are they to boils; *i.e.* the more sudden and the greater the change in their diet and general regimen, the more liable are they to boils.

Here, again, the condition of the blood predisposing to boils is induced by an alteration of the diet both in quantity and quality, by the unusual muscular exercise producing an increase in the urinary and cutaneous secretions, and a rapid metamorphosis of tissue.

The long-continued slow absorption of certain animal poisons by inhalation will in very many people, not thorougly acclimatised to the atmosphere of dissecting-rooms and pathological theatres, produce what we term the furuncular diathesis. For confirmation of the above statement we would refer, without fear of contradiction, to those whose duties compel them to a daily and prolonged attendance in the atmosphere of a dissecting-room; and to such as doubt the relation of cause and effect in this case, we would say, under a strong and painful personal conviction of the truth of the above statement, 'experto crede.'

The contact of certain cadaveric emanations and animal secretions is, so far as we are aware, the only local cause which is of itself sufficient to cause boils; such boils, or at least the first of the crop, being situated on the part to which the poison has been applied. It is not uncommon in making a post-mortem examination where the wrists and hands come freely in contact with the fluids of the corpse to feel a peculiarly stinging sensation on the surface; and in a period varying from a few hours to a few days afterwards, one or more boils may in such a case (or where no such sensation has been experienced) appear on the surface of the hand or forearm. These boils generally commence in one of the hair-follicles on the hand or forearm, these being the spots where the poison finds most ready access to the surface of the cutis.

A statement has been made by Mr. Gamgee concerning the influence of certain animal poisons taken in the shape of food in the production of boils.* He states 'that the flesh of animals affected with pleuro-pneumonia, when eaten by man, causes boils and carbuncles to an incredible extent. My observations,' says Mr. Gamgee, 'were made in three establishments; one where 1,500 persons were known to be supplied with diseased meat; another where several hundred soldiers were in the same position; and a third where seventy persons fed too often on the flesh of diseased animals.' It would be interesting to know the exact data upon which Mr. Gamgee founds this statement.

It is a matter of experience familiar to many, that mere changes of diet, and especially the more liberal supply of animal food to those accustomed hitherto to a scanty supply, will not infrequently bring about an eruption of boils. We see this exemplified in the case of young persons leaving their homes in the country and coming to the metropolis or elsewhere as domestic servants; such persons, 'servants in their first place,' as they are conventionally termed, are peculiarly liable to boils until they become used to the more liberal scale of diet.

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* 'The diseases of Animals in relation to public health,' *Edinburgh Veterinary Review*, 1863, p. 258.

There is a curious but unexplained relation existing between the diabetic diathesis, and that which precedes or accompanies the eruption of boils: on the one hand, these latter are notoriously frequent in persons suffering from diabetes; and on the other Prout, Wagner, and others have related cases of transient diabetes occurring during the outbreak of boils.* We have examined the urine in several cases, but have failed to confirm these observations. In addition to the probable causes of boils enumerated above, there are many and various circumstances producing a condition of general constitutional debility, during which, the patient may be attacked by boils; such as prolonged lactation, measles, scarlatina, and the continued fevers. But the conditions to which we have alluded more at length, furnish examples where the cause and effect bear more evident and constant relation to one another.

From the above considerations it would seem that the appearance of boils cannot always be connected with that condition of the system which passes under the sufficiently indefinite term 'debility;' nor can these eruptions be usually ascribed to mere alterations of quantity in the blood—to conditions of anæmia and plethora; but it seems probable they are more often due to some change in the quality of the circulating fluid.

In the instances cited, we have either the definite introduction of some poison into the system, through the lungs in those employed in dissecting-rooms, through the alimentary canal in those consuming diseased meat; or its application to the external surface of the body, as in the case of the boils of pathologists. Or we may suspect the presence of some abnormal constituent of the blood, as in the boils accompanying diabetes and pyæmia. In other cases we have cited, there is such a change of diet and general regimen as to favour the supposition that the quality of the blood has been altered by a change in the proportionate quantities of its normal constituents.

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* M. Vulpian has recorded a case of temporary diabetes during the progress of a carbuncle. *Gazette hebdomadaire*, 1860, No. 49.

In persons predisposed to the formation of boils from constitutional causes, the exact seat of the malady is in many cases determined by some local irritation producing transient congestion of some spot on the external surface. Thus those who, by training for rowing, have acquired a predisposition to the disease, will generally suffer on the parts most exposed to local irritation—this part, from the nature of the exercise, being generally the buttock.* In others, the friction of the braces as they pass over the shoulders will localise a boil. Again, the forehead, just where fretted by the rim of the hat, is a favourite spot for their occurrence; and the nape of the neck, where chafed by the shirt-collar, is another. Again, we have seen boils on the back of the first knuckle of the thumb in those employed in cutting out cloth, from the pressure and friction of the scissor-handles.

Among other sources of local irritation, the application of a blister is occasionally followed by a crop of boils on the part; a poultice in some has the same effect, especially if kept long applied; croton-oil liniments in others will localise the disease; and the application of a piece of soap-plaster, as mentioned by Sir T. Watson, has been known to be followed by a succession of boils.

In many cases, however, no local cause can be assigned, and these pests may invade capriciously almost any part of the body; in our own experience we have known two instances of boil on the penis—one on the dorsum, and one on the under surface. Mr. Coulson has met with one on the dorsum of the foot; and they are not infrequent on the backs of the hands and fingers, while the palms of the hands, and soles of the feet happily seem altogether exempt from the disease, and the hairy scalp is not often affected, though it is by no means exempt.

The structure of the integument of the part affected exercises a considerable influence over the character and progress of a boil. In the axillæ, the perineum, and parts where the subcutaneous tissue is loose, boils are, for the most part lumpy, elevated, and clearly circumscribed in their boundary, and the core is earlier and more easily discharged than from those situated over the thick leathery integument of the nape, and the dense skin on the outsides of the forearms and thighs. In these parts the swelling is less prominent, more diffuse, and the slough slowly and more painfully separates from its subcutaneous connections.

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* In rowing the palms of the hands are more exposed to irritation than the buttock; but they are parts of the body exceptionally exempt from this disease.

In infants and young children boils are infrequent; and if they occur, their ordinary progress is somewhat modified, especially if the child be fat; the death of the cellular tissue is more extensive, and the loss of skin by sloughing greater; the disease in its course and termination more resembles the phlegmon of young children.

The local mischief occasioned by boils is, for the most part, transient, though the cicatrix is often permanent, since the skin, at the central point of the swelling, is not merely perforated by the escape of the core, but suffers loss by sloughing.

Twice only has it fallen to our lot to witness any serious or permanent local injury. In one of these cases, a stricture resulted from a boil situated on the under surface of the penis; in the other, the sloughing during the progress of a boil laid open the sheaths of the flexor tendons of the hand, just above the annular ligament of the wrist. This accident led eventually to destructive suppuration of the wrist-joint.

The effect of boils on the constitution at large cannot but vary with the state of the general health at the time of attack. From the consideration of some of the known causes of boils, one may venture to conclude that their action is in certain states of the blood eliminative, though their frequent occurrence, from the amount of suppuration and discharge accompanying them, and the pain they occasion, may induce or increase a condition of general debility. A more serious, but happily an infrequent, effect of boils is the purulent infection of the blood and the production of pyæmia.

Of this the following will serve as an instance.* A gentleman aged forty-six, who had suffered many times before from boils, was attacked with one on the back of his hand, which, contrary to his usual custom, he allowed a surgeon to open by incision. In a few days he was well enough to go out of doors; but the day following he was attacked by pain in the chest and dyspnœa; this was followed a day or two later by intense pain in the left hip-joint, severe constitutional fever, pain and swelling of both wrist-joints, increase of the dyspnœa, and death three weeks after the opening of the boil. The post-mortem examination disclosed an abscess in the left hip-joint, turbid fluid in both wrist-joints, and numerous pyæmic abscesses scattered throughout the lungs.

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* I am indebted to Mr. Edward Newton for the particulars of this case.

Treatment.—In considering the constitutional treatment generally adopted for boils, we shall for convenience separate the rational remedies, as they may be called, from the empirical.

When the cause of the attack is assignable with some degree of certainty, there is a definite indication of the line of treatment most likely to prove successful. Thus, boils resulting from the slow absorption of poisons emanating from decomposing bodies in dissecting-rooms or elsewhere, are best treated by the early administration of a laxative, by procuring a free excretion from the skin by means of the Turkish bath, warm-baths, hot-air or vapour baths, or, better still, by muscular exercise in the open air; and by a liberal and mixed supply of nutritious food with stimulants in moderation.* In such a case, if a tonic seem desirable, quinine, with mineral acid or some preparation of bark, will be found most suitable.

The indications for treatment are also definite where boils are occasioned by a sudden change either in the quantity or quality of the food; and in such instances the remedies naturally suggested by the circumstances of the case are for the most part successful. In such it may generally be observed that the diet has consisted chiefly of some one class of food, to the exclusion, either partial or complete, of some other; or that the crop of boils has been preceded by some system of diet and regimen which enforces either a complete abstinence from, or a very restricted use of, alcoholic stimulants. We are here referring particularly to the scale of diet adopted by persons under training, or the hydropathic system.

If, in contradistinction to these systems, we observe the effects of a well-selected and sufficiently-varied scale of diet on a number of individuals of various ages and both sexes, the contrast is striking. Mr. Gover, resident medical officer at the Millbank Prison, informs us that he imagines there is scarcely any establishment of equal size in which boils are so infrequent as at that prison. Out of a population of 1,000, they scarcely have a dozen cases in a year. 'I presume,' says Mr. Gover,

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* During the progress of a boil, and before it has burst, stimulants, if given in large quantities, may much increase the pain.

'that this is due to the compulsory regularity in the habits of the prisoners, the attention paid to cleanliness, and to the fact that the diet, while not in excess, contains every element in due proportion.'

The condition of the urine often furnishes a satisfactory guide to the plan of treatment most suitable to the case—we mean an alkaline reaction, or one of abnormal acidity. The saccharine condition of urine, which has been found associated with boils by some observers, suggests a dietary theoretically appropriate; in practice, however, its adoption has not been followed by any marked success.

The effects of prolonged lactation, the convalescence from fevers or other exhausting diseases,—all of these conditions present sufficiently appreciable deviations from the standard of health to afford a guide to the treatment of boils resulting from them.

But there still remains a large number of cases in which either no definite cause can be assigned for the attack, or in which, though the cause be recognised, the rational plan of treatment has not proved successful. To such cases the various *empiric remedies* are applicable; and first among these remedies we would rank *yeast*, both on account of our complete ignorance of its action on the animal economy, and from the beneficial and speedy effect it apparently exercises in a certain limited number of cases. It may be taken fasting, a tablespoonful at a time, three times a day; and its use need not be continued longer than a fortnight or three weeks; since its effects, if beneficial, are soon evident.

Quinine, given in the manner recommended by Dr. Jackson of the United States,* may be reckoned an empirical though successful remedy. Dr. Jackson's plan is the following: he gives from 'twelve to sixteen grains of the sulphate of quinine, divided into three or four doses, on the first day; and if the peculiar effects of the medicine on the head and ears do not take place, he increases the quantity next day by four grains; and continues to increase the quantity daily by four grains, until there is some evidence that the patient has got as much as he can comfortably bear. On the day after some inconvenience is occasioned by the medicine, the daily quantity is diminished by four grains. If this is borne well, or whatever daily allowance is borne with ease, is continued for four or five days, and then gradually reduced to two grains in a day.' Dr. Jackson recommends that the quinine should not be entirely given up for three or four weeks, and insists on the necessity of beginning with large doses, so as to make a distinct impression on the system as early as possible.

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* *Letters to a Young Physician*, Boston, 1855.

Acids or alkalies are occasionally administered empirically: that is, when there is no particular indication of their being required; they are in such cases given in large doses, and are generally combined with some tonic.

Local treatment.—The list of local applications for boils, starting from the time-honoured prescription of the prophet, which is still popular among the poor, includes substances many in number, and very various in their nature and consistence; and first, of the reputed curative measures—

Boils may be subjected to treatment of an abortive kind, and occasionally so with some success. Whatever remedy be employed with this object in view, the period when it is likely to prove successful is only in the very early stage of the boil's existence, and, so far as our personal experience extends, chiefly in the case of blind boils.

This variety may often be quenched early by the application of nitrate of silver, in the solid stick, to the part of the swelling where the vesicle is about to form: a drop or two of the strong liquor ammoniæ or liquor potassæ applied to the same part is said to have the same effect; and strong tincture of iodine is recommended for the same purpose. *Incisions* are highly extolled for the abortive treatment of boils by Dr. Jackson, whose work we have quoted above; he recommends the boil, when it is but two or three days old, and but a 'pimple,' to be split with a knife. Mr. Hunter,* Mr. Syme,† and many others recommend incisions as limiting the extent of the disease, diminishing the pain, and hastening the cure. All agree in advising that the incision, to be efficacious, should be complete, and employed early. We cannot but think that the employment of incisions for boils is of questionable advantage, as a general plan of treatment; it is seldom that the case is submitted to medical inspection until all hope of an abortive incision is at an end; and we question very much if the advantages claimed by Mr. Syme for his method of local treatment would willingly be purchased by most patients at the cost of the short, though sharp, pang suffered during the division of the boil: there are, however, exceptional cases of severe local pain where an incision may be practised with great relief to the patient's suffering. *Poultices* are applications which give some relief from the pain, and quicken the process of suppuration; at the same time they tend to increase the extent of the boil, and favour the formation of fresh ones in the neighbourhood; if used at all, they should be small. Water-dressing is a better application of the same kind, as being more easily localised.

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* Hunter, *On the Blood.*

† A clinical lecture by Mr. Syme, *Lancet*, March 8, 1856, p. 269.

An application which has great repute as a domestic remedy for boils is the bark of the slippery elm; a piece of this soaked in water forms a soft mucilaginous pulp, which, applied to the part, has much the same effect as a poultice. *Boils*, unless exceptionally painful, or occurring on very incommodious parts of the body—where their rapid suppuration and speedy recovery is all-important—are best simply protected from external injury by some unirritating form of plaster spread upon leather; soap or lead plaster spread upon kid or chamois leather is an excellent application until the boil has burst, when perhaps the emplastrum or ceratum resinæ are more suitable from their stimulant properties.

CARBUNCLE.

Anthrax or carbuncle is a specific form of local inflammation attacking the subcutaneous tissue and involving the skin; it is attended by effusion of unorganisable lymph, followed by sloughing of the central and deeper parts, and subsequently by destruction of the skin and the separation of the dead tissues in the form of a slough.*

It may be distinguished from a boil by being less clearly defined in its margins, less conical at the centre, for its size less prominent on the surface, and by its manner of perforating the skin by several apertures. At the same time it extends more deeply than a boil, the redness of the skin is of a more livid hue, the pain is more severe, and is accompanied by more constitutional disturbance. Again, unlike boil, it generally occurs singly, and for the most part affects certain localities; it belongs especially to certain periods of life, and its slough differs in its colour, consistence, and attachment to surrounding parts from that of a boil.

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* For a summary of the various opinions concerning the pathology of carbuncle, see a paper by Mr. Ledwich, *Dub. Quar. Journ.* November 1856; also *Dub. Quar. Journ.* February 1864. Mr. Syme, *Lancet*, 1856, vol. i. p. 269, states decidedly that the disease 'is not subcutaneous, but seated in the skin itself.' Having carefully read his description of carbuncle, we must conclude that it differs in some points from the actual phenomena of the disease as it occurs in London.

Carbuncle shows a decided preference for the male sex; out of 2,818 deaths from carbuncle during fourteen years, namely, from 1847 to 1860 inclusive, taken from the Registrar-General's Reports, but 784 were females.

The disease has notoriously been more prevalent in some years than in others. The deaths registered from this cause gradually increased in number from the year 1847, when they were 77, to 1854, when they reached 300. Since the latter date they have fluctuated between 266 and 193 per annum. In the year 1868 they were 228.*

These fluctuations in the yearly death-rate have occurred unconnected, so far as we can discover, with any unusual or peculiar atmospheric condition. The deaths have occurred from this disease chiefly among the middle-aged and those more advanced in life, being most frequent between the ages of 45 and 55.†

The common form of carbuncle is rarely met with under the age of twenty; while that variety to which we shall presently allude under the name of malignant or facial carbuncle, generally occurs in persons under thirty years of age. The disease attacks all ranks of life; the upper classes being quite as liable to it, if not more so, than the ill-fed and over-worked poor.

The causes of carbuncle may be generally stated to be purely of constitutional origin, and to depend, when any cause can be assigned, upon conditions of general debility or plethora; while not rarely, individuals are met with, who, without showing any

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* In the Registrar's tables the numbers stand thus:—

Year.	Males.	Females.	Total.
1847	50	27	77
1848	58	33	91
1849	64	17	81
1850	102	32	134
1851	112	49	161
1852	167	66	233
1853	190	62	252
1854	218	82	300
1855	177	78	255
1856	192	61	253
1857	175	77	252
1858	181	65	246
1859	169	67	236
1860	179	68	247

† Address by Mr. A. Pritchard, *Brit. Med. Journ.* August 8, 1863.

perceptible deviation from the standard of health, exhibit what may be called the carbuncular diathesis—an unfortunate predisposition to the disease. Many causes have been assigned as tending to produce carbuncle, while some have considered it of purely local origin.* It is, however, quite impossible with certainty to assign any particular combinations of antihygienic conditions as the predisponents of carbuncle.†

Still, from the frequent association of this disease with the gouty diathesis, one is warranted in entertaining an opinion that there is more than an accidental connection between the two, and we believe that in the same way that gout is popularly, but not altogether falsely, divided into the 'rich man's' and the 'poor man's' gout, so might carbuncle be often traced to the effects of opposite hygienic conditions acting on the gouty diathesis.

By some the prevalence of carbuncle during the last few years has been attributed to the more extended use, as an article of food, of the flesh of animals affected with pleuropneumonia and splenic apoplexy, diseases which during the same time have been increasing in frequency among stall-fed cattle. On this point Professor Gamgee makes a statement to the effect that he has traced the prevalence of boils and carbuncles to the use of diseased meat in certain establishments where this kind of flesh is largely consumed as food.‡ Recorded facts, however, are wanting to establish the accuracy of this statement.

Dr. Livingstone, on the same subject, writes: 'When the flesh of animals that have died of pleuropneumonia is eaten, it causes a malignant carbuncle; and when this appears over any important organ, it proves rapidly fatal. It is more especially dangerous over the pit of the stomach. The effects of the poison have been experienced by missionaries who have partaken of food not visibly affected by this disease.

'Many of the natives who persisted in devouring the flesh of animals which had died of this distemper, died in consequence. The virus is destroyed neither by boiling nor roasting.'

On the other hand, cases are recorded where the flesh of animals that, by external contact, produced malignant pustule in one individual, was eaten as food by others with impunity.* The same author relates an instance of two butchers who were attacked with charbon after having killed and dressed the carcass of a diseased ox, which, as an article of food, proved both wholesome and savoury.† Again, the flesh of sheep affected with carbuncular disease is eaten largely in Scotland, and that with impunity.‡

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* Address on Surgery by Mr. Pritchard.

† See report on carbuncle, *Med. Times and Gaz.* 1854, p. 567.

‡ The passage is quoted at length in the section on 'Boils.' See also some remarks by the same gentleman, *Lancet*, 1864, vol. i. p. 187.

The question of the wholesomeness, or the contrary, of the flesh of diseased animals as an article of food, and its capability to cause carbuncle, is at present *sub judice*; and until those who attribute carbuncular disease to this cause can adduce *facts* in proof of their assertions, we may fairly state that their case stands 'not proven.'§

Seat of carbuncle.—The disease is most usually situated on the back of the trunk or neck, occasionally encroaching on the hairy scalp, on the buttocks, or the extensor surface of the limbs, on the upper or lower lip; its favourite seat being in the dense and fibrous integuments over the posterior median longitudinal line of the body. Carbuncles have been observed on the front of the abdomen and on the sides of the thorax. As a rule they appear but one at a time, though they may follow one another in succession.

Through the kindness of Mr. Wood of Shrewsbury, we are enabled to quote an exceptional case where the patient at one time suffered from eight; this gentleman had, on a previous occasion, been attacked by carbuncles. He was a free liver and a large, very large eater, and he eventually died almost covered with carbuncles, having at the same time four on the back, one on the nates, two or three upon the abdomen, and one on the thigh; they were many of them very large.

A carbuncle, as it generally occurs, begins in a painful inflammatory swelling of the integuments, hard to the touch, red in colour, very obtusely conical in shape, and ill-defined in its boundaries; it gradually increases in extent and hardness, diffusing itself through the surrounding cellular tissue as a kind of inflammatory œdema. After a few days the colour becomes darker, the more prominent parts being of a livid red, where the cuticle is generally raised from the cutis by some sanious serum; on the bursting of this vesicle the cutis is seen to be perforated by several small yellow apertures, which give exit to a glutinous purulent fluid. After a time these separate holes, from the death of the intervening skin, merge into one large ragged-looking opening. At the bottom of the cavity thus exposed is seen a slimy, pultaceous slough, extending into the interstices of the surrounding cellular tissue beneath the sound skin, and possessing, as some think, a characteristic fœtor. During all this time the inflammatory œdema around may have been extending; but on the full exposure of the slough it generally begins to subside, the pain lessens in intensity, suppuration commences, and the dead parts slowly, and as it were reluctantly, separate from their connections, leaving a cavity of very irregular shape, having generally deeply undermined and jagged edges. In the progress towards cure, this is filled-in by granulations up to the level of the skin, and when cicatrised leaves an uneven and often permanently discoloured scar.

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* Bourgeois, *Pustule maligne*, p. 73.

† Ibid. p. 165.

‡ *Med. Times and Gaz.* 1863, p. 564; also 1864, vol. i. p. 217.

§ We do not of course allude to parasitic diseases.

The ordinary progress of carbuncle, as above described, may occupy an uncertain interval of time extending from a fortnight to some months; indeed, in a few instances, the vitality of the skin for a long while resists the sloughing process which takes place in the tissues beneath, giving rise to a chronic carbuncle, where the slough is both slow to form, and when formed is for a time imprisoned by the integuments; such carbuncles, if opened, have the appearance of an abscess with semi-solid contents.

The slough consists of the subcutaneous cellular and fibrous tissues, abundant oil-globules, and the products of the inflammatory process in various stages of disintegration. The depth to which it penetrates is uncertain; but not infrequently on the separation of the dead parts the muscles below are seen completely bared, or even to some extent involved in the sloughing. To such a depth may the disease extend that a carbuncle on the anterior abdominal wall may produce fatal peritonitis.*

Death may occur in this disease from exhaustion caused by the sloughing and discharge from the carbuncle; these, however, alone rarely produce sufficient depression of the vital powers to cause death; more frequently, if death occurs in this manner, the fatal exhaustion has been occasioned or aggravated by hæmorrhage from incision of the carbuncle.

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* *Brit. Med. Journal,* August 8, 1863, p. 152.

When the disease invades to any extent the hairy scalp, death may occur in the same manner and from the same cause so frequently seen in erysipelas of the head; the fatal issue being conventionally attributed in these cases to cerebral effusion, or inflammation of the membranes of the brain.

By far the most frequent and efficient cause of death in carbuncle is pyæmia, as characterised during life by rigors, profuse sweats, and general depression, and occasionally by the formation of external abscesses, and as evidenced after death either by multiple deposits of a fibrino-purulent nature in the liver, lungs, kidneys, and spleen, or by secondary abscesses in the same organs or elsewhere.* During the progress of the carbuncle the urine is thought by many to be saccharine. Cases of this kind have been recorded by Prout, Wagner, and M. Vulpian. But we believe this may be merely a coincidence, as we have been unable to find glycosuria accompanying the attack of carbuncle, nor was this condition of the urine found to exist in thirty-five tabulated cases reported in the *Medical Times and Gazette* for 1854, p. 569.

Treatment.—Since such conflicting opinions exist on the subject of the local treatment of carbuncle, and as surgeons of eminence and experience take such strong and opposite views on the question, we shall briefly allude to the most common plans of practice. At the same time we venture to suggest that some of the warmest supporters of particular and exclusive methods of treatment seem to pay but little heed to the collateral circumstances of each particular case and the general condition of the patient.

And first, there are those who advocate and practise incisions of various kinds, as exercising a direct effect in the limitation of the disease both in its duration and extent.

Secondly, those who repudiate incisions and advocate various kinds of caustics, ascribing to these a similar effect.

Thirdly, there are those who make use of local applications, of a more simple and less heroic kind; and, distrusting the efficacy of both caustics and incisions as means of limiting the extent of the disease or hastening its termination, trust to the constitutional powers of the patient, and the general tendency of local inflammatory diseases to bring about a favourable issue. More recently a plan of local treatment by pressure has been introduced; it is said to limit the extent of the disease, to relieve the pain, and to hasten the separation of the slough.

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* For instances of death by pyæmia from carbuncle, vide *Guy's Hosp. Rep.* 1861, p. 466.

1. The treatment by incision is adopted in the progressive stages of carbuncle; that is, at any time before the slough has begun to separate, or the inflammation to subside; it is probably the most popular plan of local treatment; and it generally consists in a free crucial division of the carbuncle from the surface towards the deeper parts, extending into the living tissues around and beneath.

An internal or subcutaneous crucial incision has been recommended by Mr. French. In this method a tenotomy knife, with its edge upwards, is introduced into the circumference of the induration; and the whole mass is divided from the deeper parts towards the skin, taking care not to wound the latter, except at the point of puncture; a second subcutaneous division is then made, in the same way, at right angles to the first. When the bleeding has ceased, Mr. French recommends that the surface of the carbuncle be covered with collodion, the slough being allowed to escape through the punctures in the base of the swelling.

Another species of subcutaneous division is employed by some; the parts being split horizontally. By others, the swelling is subcutaneously broken up, and subdivided with a long narrow knife passed in at the side.

2. The method of local treatment by caustic consists in the free application of caustic potash in substance to the centre of the tumour, until the latter is thoroughly disorganised. This plan has been highly recommended by Dr. Physic, and at his suggestion has been extensively adopted in America; while in this country, among others, Mr. Higginbottom and Mr. Pritchard have chiefly advocated the same treatment, which is thus described by the latter gentleman: 'In whatever stage the carbuncle is, the potash is to be applied, and rubbed in freely in the centre until an eschar is fully formed. In the earlier stages, if the skin is still unbroken, it must be used for several minutes, until the death of the central portion is insured; the size of the slough to be made varies with the size of the carbuncle. In general terms, the diameter of the skin to be destroyed should be a fourth, or even a third of the diameter of

the indurated and inflamed mass.' This, says Mr. Pritchard, is generally sufficient to stop the progress of the disease. Subsequently, the parts are to be covered with resin, turpentine, or camphor cerate, poultices being avoided. The circumference of the swelling may be covered with collodion, or a strong solution of lunar caustic. Strict cleanliness is to be observed, and the slough allowed to separate spontaneously.

The advantages claimed for this plan of treatment are the following: the avoidance of hæmorrhage; a diminution in the extent and duration of the disease, and thereby a saving of strength to the patient; and a freedom from pyæmia.*

3. Coincidently with a wide-spread and increasing belief in the general tendency of local inflammatory diseases towards spontaneous recovery, a doubt has arisen in many minds of both the efficacy and necessity of such remedial measures as have for their object the cutting short of the progress of a carbuncle. Thus it is that many surgeons, formerly advocates for crucial incisions, are now content to allow the local malady to run its course; while, by a judicious administration of constitutional remedies, they endeavour to husband the strength of the patient, and to place him in the best position to support the tax on his vital powers. This treatment is adopted on the conviction that neither local incisions nor caustics favourably influence the duration or extent of the disease; while by avoiding incisions, one source of danger—that of exhaustion by hæmorrhage—is altogether excluded; and this is no questionable advantage in old or enfeebled patients. At the same time, another perilous complication, that of pyæmia, is less likely to occur in this plan of treatment than in the case where incisions are employed.

The application of pressure as a curative agent to carbuncles was first advocated, we believe, by Mr. O'Ferrall,† who has since embodied his views and experience on this subject in a pamphlet. Strong testimony to the efficacy of this plan of treatment has also been given by Mr. M. H. Collis, in the *Dublin Quarterly Journal*, Feb. 1864.

The manner of applying pressure is thus described by Mr. O'Ferrall: 'The compression must be firm, and must begin at the periphery of the swelling, and gradually approach its centre. In the early period of the practice, I was accustomed to apply a circular piece of brown soap-plaster, spread on leather or cotton cloth, leaving an opening for the discharge of the pus. This succeeded in many instances; but I found that a firmer support was necessary, in order to give immediate ease to the patient. I therefore covered this piece with straps of plaster, drawn tightly from the neighbouring sound parts, and they by traction exerted a firm degree of compression on the swelling. In some localities, where the tumour is of small size, and traction of the skin not easily accomplished, I have found a coating of collodion of considerable service, producing, by its contractile properties, a nearly similar result.'*

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* Vide a comparison between the results of treatment by incision and by application of collodion, *Year-Book of Med. and Surg.* 1862, p. 165.

† *Dublin Hospital Gazette*, 1858, 'On the Treatment of Anthrax by Pressure.'

In reviewing the methods of treatment, we believe that that by incision has the advantage of very generally affording complete relief from pain; that it arrests the further extension of the inflammation is less certain, and we much doubt if the final cure is by it at all expedited.

Among the various kinds of incision for carbuncle, we have not been able to discover that any method possesses an advantage over the time-honoured crucial cuts. The treatment by incision has the disadvantage of causing hæmorrhage, and, it may be, of exposing the patient's life to increased risk from pyæmia; if employed after a carbuncle has ceased to make progress, this treatment may do damage by interfering with the natural process of cure, and by increasing the area of sloughing and suppuration.† No universal plan of incising carbuncles, as recommended by Mr. Syme, can be adopted without great danger to many sufferers from the disease. To the young and vigorous, the employment of the knife may bring relief from pain without risk to the general strength; while in the case of those who are debilitated by age or other causes, the questionable local advantages of incision are far outweighed by the certain risk incurred by the constitution at large.

As a local application after the division of a carbuncle, a poultice may be used, or, what is better in many cases, lint steeped in turpentine, spread over the surface; or if there is any tendency to continued hæmorrhage, the lint may be stuffed into the cuts with a probe.

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* *Dublin Hospital Gazette*, 1858, 'On the Treatment of Anthrax by Pressure.'

† Vide *Med. Times and Gaz.* 1854, p. 571, report on carbuncle.

Of the employment of caustics we have no personal experience; it is a plan strongly recommended by competent observers and surgeons of high repute, who have had large opportunities for forming a sound and discriminating judgment on the subject. Of local applications to carbuncle (until the slough begins to separate), the most comfortable to the patient is the common linseed-poultice, or wet lint and oiled silk; the poultice is of itself too relaxing to many skins, and liable to give rise to boils in the neighbourhood; it is rendered more suitable to the particular malady by being smeared over with turpentine and resin cerate. Frequent syringing with warm water, a weak solution of chloride of zinc or of carbolic acid, will quicken the process of separation when the slough has fully formed; and occasionally from large carbuncles considerable masses of slough may be advantageously cut away with scissors.

To the granulating surface after the separation of the slough some application of a stimulant kind is best suited, such as the Peruvian balsam or the cerate of turpentine and resin; while the edges of the cavity may usefully be approximated by careful strapping with plaster.

The constitutional treatment and general management of patients suffering from carbuncle is best conducted on general principles, and on such indications as the age, circumstances, manner of life, and standard of health of the patient afford, and not upon any specific or universal line of treatment directed to the particular disease.

The bowels, if they require attention, may be acted on by some non-irritating aperient; and the diet, if it be necessary to give much nourishment, should be given in an easily assimilable form. It occasionally happens that, starting from the carbuncle, an erysipelatous inflammation of the skin spreads to the parts around; this it is advisable to treat either by the application to the surface of strong collodion, or a paint recommended by Mr. Pritchard of Bristol, consisting of iodide of potassium and iodine, each a scruple, to one ounce of collodion;* or the strong caustic solution recommended by Mr. Higginbottom may be advantageously applied.

Facial carbuncle.—Under this name we propose to describe a disease of carbuncular character, which often differs in its progress and consequences so much from the ordinary affection as to require a separate notice. Having most external characteristics in common with carbuncle; in its constitutional effects, this disease may be said to bear much the same relation to the latter as does scarlatina maligna to scarlatina simplex. Whether the fatal tendency of facial carbuncle depends upon the structural peculiarities[*] of the part affected or upon the essential nature of the disease, we shall not venture an opinion.

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* *Brit. Med. Jour.* 1863, p. 155.

Facial carbuncle has been described, under the name of multiple furuncle of the face, by M. Dumereuil.[†] It has been alluded to as agminated furuncle of the face by Bourgeois, in his work on malignant pustule. In this country, as we believe, the disease was first described by Mr. Harvey Ludlow, in a paper entitled 'Carbuncular Inflammation of the Lips and other parts of the Face;[‡]' and this is one of the best accounts of the disease that is published.[§] The cases published by Mr. Ludlow have been claimed by a recent writer on malignant pustule as instances of the latter affection.[||] 'The cases reported by Mr. Ludlow,' says Dr. Budd, 'are all characteristic examples of malignant pustule.' From this assertion we venture entirely to dissent. In speaking of cases of facial carbuncle, M. Bourgeois, in his work on malignant pustule, states that it is not uncommon to meet with a fatal termination when carbuncle occurs about the mouth or other parts of the face; and that this disease is to be distinguished from malignant pustule by its painfulness, the presence of pus, the character of the swelling, and by other characteristics to which we shall presently allude.

In support of the opinion expressed above, we would direct attention to the following particulars: M. Bourgeois[¶] remarks of malignant pustule that its name is singularly inappropriate, since it conveys an idea of some purulent formation; whereas the secretion of pus is so opposed to the essence of the disease that the recognition of the smallest quantity, in a doubtful case, would show the disease at once to be of some other nature than malignant pustule. At page 301 of the same work, among other diagnostic signs of malignant pustule, the complete absence of pus is enumerated, 'since if it appear spontaneously, or follow upon pressure, one can say certainly that the disease is not of the nature of charbon.'

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[*] The facial vein differs from other external veins in being less flaccid in its walls and more patent in its canal, and communicating at its lower dependent end with the jugular, and by its upper with the sinuses of the brain; thus affording unusual facilities for the escape of morbid material from its canal into the general circulation.

[†] *Gazette hebdomadaire,* 1863, No. 47.

[‡] *Med. Times and Gaz.* September 1852.

[§] See also *Archiv. gén. de Méd.* 1870, juin. *Recherches sur les causes de la gravité particulière des anthrax et des furoncles de la face,* par J.-L. Reverdin.

[||] *On the Occurrence of the Malignant Pustule in England,* by W. Budd, M.D. London, 1863.

[¶] *Pustule maligne et Œdème malin,* par J. Bourgeois, Paris, 1861.

On examining the six cases reported by Mr. Ludlow, we find that in five it is stated that pustules appeared on the surface of the part affected; while in the other case, when the diseased parts were incised during life, a thick pultaceous matter is said to have issued from the cut surface, which exhibited punctiform deposits of pus. Out of the five cases that presented external evidences of pus, four were cut into during life; and of these it is distinctly stated that there were isolated infiltrations of pus seen on the cut surface. In all these cases, therefore, pus was found to exist.

Of pain as a symptom of malignant pustule, M. Bourgeois remarks that one important diagnostic sign of the disease is the almost complete absence of pain; and elsewhere he remarks, a singular circumstance is the little pain these enormous swellings produce: while of Mr. Ludlow's cases it is related that one suffered 'intolerable pain,' another 'suffered acutely,' a third had 'sharp throbbing pain,' in another case the pain was 'very severe,' and in two cases the disease is said to have been 'very painful.'

These cases, therefore, differ from malignant pustule by possessing those very symptoms that are stated by Bourgeois to be characteristic of carbuncle of the face. In addition to this, at the time the cases occurred, the question of their being instances of malignant pustule was considered and negatived both by Mr. Ludlow and by others well qualified to form a sound and discriminating judgment.

That carbuncles form on the face, and, running the ordinary course of that malady, produce no unusual constitutional disturbance, is a matter of common observation; but that carbuncles, differing in their early stages in no recognisable feature from the above, not infrequently prove fatal, is but too true.

Facial carbuncle generally commences in a small itchy pustule or vesicle upon one of the lips (the upper lip for the most part); this vesicle, in a day or two after its rupture, is followed by a firm œdematous swelling of the lip, also of the nose and cheek, producing a hideous deformity. A few pustules, or vesicles, generally soon show themselves about the red edge of the lip, and the swelling extends; the surrounding induration being perhaps less defined than in carbuncle occurring elsewhere. The pain is most intense, and the colour of the surface generally passes through the shades of bright red, dusky red, and dark plum colour, until it is almost black, particularly about the mucous margins of the lips. Suppuration is slow to occur; but, if the patient live long enough, pus will form and be discharged together with the disintegrated cellular tissue.

The constitutional symptoms early in the disease indicate great depression of the vital powers, the pulse being generally frequent and feeble, the skin hot, and the tongue soon becoming dry. Too often rapid breathing with pneumonia or pleurisy supervenes, and death occurs from pyæmia; the purulent infection of the blood either originating in facial phlebitis, as evidenced by the swelling and induration in the course of the veins, and spreading upwards through the orbit to the cavernous sinus, where pus may be formed; or it may be the general circulation is contaminated through the facial and external jugular veins.*

The following furnishes a characteristic example of the disease; we are indebted to the kindness of Mr. Paget for its particulars. A young gentleman of moderately strong constitution, when in his usual health, noticed a small pimple on his upper lip; it gave him no pain at first, but on the second day it enlarged, and became painful; on the third day he kept his bed, with increasing pain and swelling, and some constitutional fever. He quickly became worse; and on the fifth day the whole of the left half of the upper lip, and part of the adjoining cheek were occupied by a thick hard carbuncular swelling not very distinctly defined in extent. The skin over it was dusky brownish and purplish red, and the rest of the cheek was œdematous, dusky, and hot. He had severe burning pain in the part; the pulse was 145, full, jarring, and rather hard; the tongue was dry and brown down the centre; skin hot and dry; thirst extreme; slight headache; he had had no shivering or sickness, and his appetite was good. The carbuncle was split from the mucous edge of the lip; there was considerable hæmorrhage, which recurred a short time afterwards so freely as to require pressure to restrain it. He was ordered plenty of wine with nourishing food and bark. After the incision, for the first day the swelling and pain much subsided, the face regained a more natural colour, and the patient passed a good night. On the seventh day, though the parts had lost some of their hardness, yet the general swelling had increased in extent, and pus began to be discharged in flakes from the wound. In his general condition the patient was not worse. On the eighth day the carbuncle had still further suppurated, the general œdema had extended over the eyelids, and there was marked protrusion of the eyeballs and chemosis of the conjunctiva. The pulse had fallen to 104, the skin and the tongue were moist. Next day, the ninth of the disease, the pulse fell to 84, the patient became torpid, and at length nearly unconscious. He ceased to care for his food, his urine passed involuntarily, he became restless, trying to get out of bed; the eyes were still further protruded. A purge was given, the quantity of stimulus diminished, and a blister applied to the nape. Next day his general condition was rather improved, though the eyeballs protruded more; a slough had separated from the lip, and pus issued sparingly from small holes in its surface; there was redness and swelling over the right temple. On the eleventh day, he partially recovered his consciousness and power of voluntary micturition, and seemed better generally. On the twelfth he was still better; a small abscess was opened over the nose; pustules appeared on the eyelids. The carbuncle was at this time discharging thick pus, was shrinking and softening; pulse 104, with good power; food and wine taken readily. Next day the improvement continued in all respects. On the fourteenth day he again became dull and heavy, his pulse rose to 148, his urine was retained, a swelling appeared on the parotid; meantime the carbuncle was healing, and the swelling of the face was diminishing. During the next two days he became worse; a pustular eruption appeared about his abdomen and thighs, and two abscesses on his forehead; and he sank on the sixteenth day; the carbuncle being nearly healed, the swelling on the face having almost disappeared, and the protrusion of the eyeballs having diminished in extent. During the last few days of his illness there had been noticed some fulness of the veins about the left eyelid, and a feeling of induration about the lower part of the facial veins.

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* Vide *Transactions of the Clinical Society*, 1870, 'On Malignant Carbuncle of the Face,' by T. Smith.

The cause of death in this case, as in others of which we possess the histories, appears to have been pyæmia, as evidenced, in the case quoted, by the secondary abscesses which formed, and perhaps by the pustular eruption, which, occurring as it did coincidently with an aggravation in the constitutional symptoms, probably indicated a purulent infection of the blood.

From the local symptoms alone, we know of no circumstance that will enable us to determine with certainty in cases of facial carbuncle whether the disease will be of the benign form or otherwise. Early suppuration, moderate pain, and a distinctly limited area of inflammatory œdema, are favourable signs; while the opposite conditions portend, but by no means infallibly indicate, an unfavourable issue to the case. The constitutional symptoms are often the first warning of the serious nature of the disease, and they are generally from the very first of an asthenic type; yet it not infrequently happens that nothing to excite anxiety occurs either in the constitutional or local symptoms until the access of well-marked pyæmic rigors.

Treatment.—In the treatment of facial carbuncle topical remedies seem to have even less effect upon the disease than when employed elsewhere; and incisions, if they exercise (as we believe they do) but little beneficial effect when used for carbuncle in other parts of the body, exercise still less when employed on the face. The indications for general treatment are best found in the constitution and condition of the patient; nutritious food and an abundant supply of stimulants being generally required. Mr. Paget has had good success from the employment of quinine in this disease in very large doses; sufficient, that is, to produce the characteristic symptoms of cinchonism.

MALIGNANT PUSTULE OR CHARBON.

The following description of this disease is chiefly taken from M. Bourgeois' work entitled *La Pustule maligne et Œdème malin* (Paris, 1861). For an exhaustive list of the various continental authorities on this subject, we would refer the reader to an excellent pamphlet on the occurrence of malignant pustule in England, by Dr. William Budd, who has collected a number of interesting cases to establish the existence, and even to some degree, the prevalence, of malignant pustule in our own country.

Certain herbivorous mammalia, namely, oxen, sheep, and goats; horses, donkeys, rabbits, hares, and it may be others, are liable to an internal disease, or type of disease, to which various names have been applied. As a class, these affections are termed 'charbonneux' by the French. The particular disease, as it occurs in the ox and sheep, is termed in this country 'the blood,' 'joint-murrain,' 'black quarter,' or the 'quarter evil.' The French synonyms for the same are 'quartier,' 'charbon,' and 'sang-de-rate' in the case of sheep; while in the ox the disease is termed 'le sang,' or 'maladie de sang.' In Germany the same disease is termed 'milzbrand.'

Malignant pustule or charbon in man is derived from the poison generated by this disease in animals. The disease can be communicated to man by direct contact with the hair, the hoofs, the horns, the hide, the bones, the flesh, or the blood of the diseased animal; and in this way butchers, farriers, shepherds, and curriers usually acquire the disease: while straw or other litter, hurdles, splinters of wood, stones, articles of clothing, may act as media for the communication of the disease to man. Flies and other insects that have been in contact with the carcasses of diseased animals may also transmit the disease.* The use of the flesh and milk of diseased animals is a more doubtful medium of infection; indeed, so many are the instances of a negative kind, where flesh that has caused malignant pustule by simple contact has been taken as food with impunity, that M. Bourgeois hesitates to include this as a means of infection.

Similarly, it is doubtful if the disease can be communicated by contact from man to man, or from man back to animals; such experiments having been at present always followed by a negative result. Nor is it probable that the disease can be communicated to man in the way of infection; we mean simply by atmospheric influences, and without actual contact with the poison.

The disease almost always attacks some exposed part of the body, and is therefore most common on the face and hands. This is as one would expect, from the local origin of the malady.

For some time after its onset malignant pustule is a purely local affection, and during this stage it is within control; and if the proper treatment be adopted, it can almost certainly be arrested, and the constitutional effects of the malady be averted.

The following is the usual course of the disease: from one to three days after the application of the virus to the surface of the body, there appears on the part a small red spot like a flea-bite, which is sometimes preceded, and is always accompanied by a smart itching. After twelve or fifteen hours, a small vesicle appears on this spot about the size of a pin's head, containing a little brownish-red or yellow serum, on the rupture of which the itching generally ceases, and the skin beneath is seen to be dry and of a yellowish-brown or black colour. This discoloured spot indicates the death of a thin layer of the true skin, which soon extends through its whole thickness.

In less than twenty-four hours a fresh crop of vesicles appears, distended with brownish-yellow serum; they are situated in an irregular circle around the eschar of the skin. At this time the eschar is depressed, dry, of a brownish-yellow or black colour, and but little painful on pressure. After twenty-four or forty-eight hours, the parts beneath swell, harden, and form a solid lump, which is pretty well defined in extent, and can be raised with the finger from the surrounding tissues ('bouton'): this swelling is occasionally absent. The mortification now extends up to, and even beneath, the circle of vesicles. As these are destroyed by the extension of the mortification, fresh ones form on the parts around; while the skin about, which at first was pale, reddens and finally becomes of a livid red colour. As the swelling increases, œdema comes on in the surrounding integument, which is ill-defined in its borders, gradually fading away into the healthy tissue. This swelling is but little painful, the temperature is but slightly raised, and it gradually extends itself, while bullæ form over the dead tissue towards the centre of the swelling. The central slough enlarges, but not to any great extent or depth; it is now extremely hard, while the surrounding swelling and œdema may become enormous. A curious fact, says M. Bourgeois, is the little pain that these large swellings cause; and that when they become painful it may be looked upon as a hopeful sign that a reactionary process has commenced. If the disease be situated upon the trunk or extremities, inflamed and indurated lymphatics are often seen stretching away from the swelling to the neighbouring glands. Such is the usual course of a malignant pustule: at first a red spot, then a vesicle, then a solid and circumscribed swelling beneath ('tumeur charbonneuse') surrounded by a diffused and softish œdema, a dry leathery central eschar, and a secondary formation of vesicles or bullæ.

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* Instances of nearly all the above-mentioned modes of contagion are given in M. Bourgeois' work.

The more characteristic signs as distinguishing this disease from others may be stated to be a remarkable freedom from severe pain, the little increase in the temperature of the parts, the dryness of the slough, the *entire absence of pus* in all stages of the malady, and the fact that the destruction of the tissues proceeds from the skin towards the deeper tissue, and not, as in carbuncle, by a central sloughing of the subcutaneous parts, followed by death of the skin.

Malignant pustule generally runs its course either to a favourable or fatal issue in a period varying from four to nine days. One must not suppose, says M. Bourgeois, that all malignant pustules follow this succession of changes exactly as described above. In some cases the eschar is not larger than a lentil, and occupies but a part of the thickness of the integument, the surrounding œdema hardly exceeds the 'tumeur charbonneuse' in extent; which latter may even not exist, and these differences are consistent with the most favourable or fatal issue. Still, for the most part, the more extensive the local affection, the more is there to be apprehended as regards the issue of the case.

Constitutional symptoms.—These may early show themselves; often soon after the appearance of the first vesicle, the patient being seized with rigors, headache, and symptoms of general depression. At other times the symptoms come on a few days later, most commonly showing themselves between two and three days after the appearance of the circumscribed swelling ('bouton') at the base of the eschar; very soon the tongue becomes coated with a white fur; the pulse is full, frequent, and soft; the bowels constipated; and appetite is lost. These symptoms are generally followed by bilious vomiting, depression, faintings, difficulty of breathing, loss of sleep, a coldness of the external surface, a failure of the pulse, cold sweats, and the patient generally dies in a condition much resembling that of collapse from cholera; delirium is rare. Usually before death the local swelling ceases to increase; indeed, in some few cases, may recede, while the colour of its surface becomes more livid and it loses its temperature.

Post-mortem appearances.—The decomposition of the body is very rapid. The serous cavities generally contain a small quantity of darkish serum; the blood is found fluid and dark-coloured; small ecchymoses are often found on the mucous membrane of the stomach and small intestines; the spleen is engorged with blood and softened; the liver and other parenchymatous viscera are more or less congested with dark-coloured blood.

The posterior lobes of the lungs are much loaded with blood, and the bronchial mucus is blood-stained.

The heart and brain show the same tendency to early softening and passive congestions; the local slough, if examined, is found to consist of dry stratified layers, dark brown or black in colour, like old leather in consistence, and creaking when cut with a knife.

Prognosis.—Of the various circumstances influencing the prognosis, M. Bourgeois enumerates—1, the age; 2, the seat of the affection; 3, the constitution of the patient; and 4, the local character of the disease, and its duration before treatment is adopted. 1, the younger the patient, the better is the prospect of recovery; 2, the head and neck are the most dangerous seats of malignant pustule; 3, as in other diseases, the amount of constitutional resistance the patient can oppose to the malady largely influences his chance of recovery; 4, it is a highly favourable circumstance if the patient is seen when the disease is still local, and before the symptoms of general blood-poisoning have shown themselves; and the prospect of recovery is less bright the longer the time that has elapsed since the onset of the malady, and the greater the severity of the constitutional symptoms. A favourable local sign is the existence of a bright-red flush over the part, and any considerable increase in the normal temperature; also the distinct limitation of the local induration may be looked upon as a circumstance of favourable augury.

Treatment.—Since this malady in its first onset, and for an uncertain period afterwards, is merely a local affection, it is for a time within the control of local remedies; these being any of the more active forms of potential cautery and the hot iron. M. Bourgeois agrees with others in recommending, as the most efficient and easily-applied form of caustic, the solid hydrate of potash, which the former gentleman uses by rubbing the solid stick of potash into and around the eschar and its surrounding vesicles, until it is thoroughly destroyed and the healthy tissues are reached; the semi-fluid detritus is then to be wiped away, and the dead parts allowed to separate by ulceration.

In cases where the disease has made great progress before being subjected to treatment, and the tissues are penetrated to some depth, M. Bourgeois recommends that a layer from the surface of the eschar be raised and removed with a knife, and the potash be then applied. In any case where the local slough extends after the application of the caustic, the latter must be reapplied as soon as the non-arrest of the local disease becomes evident.

The constitutional remedies in this disease are such as the general symptoms of the case would suggest, the indication being to avoid all measures likely to exhaust the patient, and to administer stimulants and nourishing food in an easily assimilable form.

Occasionally malignant pustule assumes another external appearance, to which M. Bourgeois gives the name of malignant œdema.* It differs from malignant pustule only in its external manifestation; in all more essential features the diseases are identical. It is generally met with about the eyelids and face. The prominent feature of this form of the disease is a softish, ill-defined, indolent-looking œdema of a pallid colour, rapidly increasing; the subsequent formation of vesicles is less regular, and the appearance of a characteristic central eschar may be absent, as also may be the central induration.

CHILBLAIN.

This term is applied to certain characteristic local inflammations of the integument of an asthenic type, subject to regularly recurring attacks of congestion. They appear in persons predisposed to the affection under circumstances of sudden variations in the external temperature.

A predisposition to this affection often prevails in certain families; it exists most frequently in the young of both sexes, and in adult females more often than in men. This liability to chilblains generally passes off as manhood comes on, and is but rarely met with in men over forty years of age, though in women it may continue throughout life.

The predisposition to chilblains is often connected with a certain slowness or feebleness of the general circulation, as evidenced by cold feet and hands, and occasional lividity of the finger-ends and lips during winter-time. Their appearance is generally ascribed, and often with truth, to the too sudden warming of a part when thoroughly chilled down by previous exposure to cold. But a change of weather, or of residence to a colder neighbourhood, a sudden thaw after snow or prolonged frost, or the appearance of an east wind, is sufficient to occasion them in many persons. In some individuals, if the hands or feet are chilled down, from any cause, below a certain standard, notwithstanding all precautions to the contrary, it is impossible to restore the temperature without producing one or more chilblains.

There are three kinds, or rather degrees, of chilblains: 1st, where there is simple congestion, generally attended by great itching, alternating with periods of extreme tenderness to external pressure; 2nd, where vesication occurs; and 3rd, where death of the subjacent skin or areolar tissue takes place.

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* Bourgeois, p. 105.

The same chilblain may pass through all these phases in the above-named order; but more frequently we find that in the same individual chilblains run a pretty constant course. In some they do not vesicate or break; in others they vesicate easily, and on breaking show superficial excoriations; in others, after breaking, the subjacent integument is found ulcerated or more completely devitalised. Again, some persons suffer from chilblains which itch but little, but show themselves as red and intensely sensitive swellings of the integuments. From the appearance of a chilblain in its early stage but little information is to be gained as to its eventual result. Most persons, however, know too well what course their own chilblains will pursue from repeated experience.

The local symptoms and appearance of chilblains are too familiar to require a special description, and we therefore pass them by to allude to a peculiarity belonging to this affection, which, we believe, has not previously attracted notice. The peculiarity to which we wish to draw attention is the regular and periodical exacerbations that occur in the local symptoms so long as the chilblain is in progress.

Almost all chilblains are subject to a diurnal attack of congestion, which occurs during the afternoon or towards evening, when the affected part, by a feeling of increased heat and a pricking sensation, shows signs of an increased afflux of blood; this is soon followed by intense itching, then by swelling, with relief to the irritation; and lastly succeeds a condition of soreness, aching, and extreme sensibility to pressure, which continues throughout the night, and is peculiarly appreciable next morning, when the sufferer puts on his shoes or boots.

The exact hour of the daily attack of congestion, as well as its severity, may, within certain limits, be influenced by external circumstances. Thus the attack may be hastened by anything which stimulates either the local or general circulation of the body, such as the exposure of the parts affected to the warmth of a fire or a heated room. The constitutional effect of the midday meal in children, and the evening dinner in adults, is generally sufficient to determine the period of attack; children for the most part suffering in the afternoon, adults in the evening, during or after dinner; conversely the opposite effects may be observed where external circumstances are unfavourable to the advent of the attack, which latter may be postponed until after the sufferer has retired to rest. In many young persons at boarding-schools the extremities are cold throughout the day; and it is not until the child is in bed that the general temperature is restored to its natural standard. The severity of each daily exacerbation generally bears a direct relation to the degree of cold to which the patient has been previously exposed; and the colder the chilblains are in the morning, the more will they itch in the afternoon.

We have occasionally met with persons whose chilblains are subject to two attacks of congestion daily: the first occurring late in the afternoon; the second at night-time, when the parts are warm in bed. In some few persons chilblains do not itch at all—they tingle and burn during the daily attack, and at other times are swollen and extremely tender.

During the onset of the diurnal exacerbation the general circulation is quickened, and the temperature of the affected part is considerably raised, being often ten degrees or more above that of the part before the attack set in, and from one to six degrees above the neighbouring surface of the healthy skin.

Chilblains generally appear on those parts of the body where the circulation is most liable to be affected by changes in the external temperature. In the same individuals, however, the part of the body attacked every winter is little liable to vary. Some suffer on the hands alone; others on the feet only; while others may be attacked on both hands and feet; or, again, the lobes of the ears may be the seat of chilblain, or even the end of the nose.

Of the local causes of this affection those are most efficient that hinder the free circulation in a part, and thereby allow external cold to exercise its most depressing effects; such are tight gloves, elastic bracelets and garters, tight shoes, sitting long in cold rooms with the feet pendent, and other circumstances of a like kind.

Treatment.—Though in some persons no precautionary measures will prevent the occurrence of chilblains, nor will any remedy remove them, yet even in these individuals both their number and their severity may be favourably influenced by appropriate treatment; while in other persons the attack may be either altogether avoided, or if it occur, the chilblains may be cured.

Of general measures either to prevent or mitigate the severity of an attack, the most efficacious are such as promote a vigorous state of the general circulation. In matters of diet, the addition of a glass or two of wine to the daily food, or a morning draught of warm milk with rum will often prove of service; while if medicine be required, small stimulant doses of opium with quinine may be advantageously given. In persons liable to chilblains, and especially in young people, additional under-clothing should be worn during cold weather; and, if possible, an even temperature should be maintained within doors by fires in the sleeping-rooms—for among time-honoured conventionalities, none, in the case of young persons, is more conducive to chilblains than the great inequality that generally exists between the temperature of the sleeping and sitting rooms during winter-time.

The circulation and temperature in the extremities are best maintained by warm and particularly by roomy coverings for both feet and hands. For the hands, loose gloves lined with chamois-leather are best; and for the feet, large boots or shoes, and wash-leather or woollen socks. Tight gloves and shoes, tightly-laced boots, and garters, and elastic bracelets, should be particularly avoided.

As long as chilblains remain unbroken, and if the external surface is not too sensitive to pressure, various stimulating embrocations may be beneficially employed: such as Wardrop's liniment; a mixture of two parts of tincture of cantharides with six of soap-liniment; camphorated spirit; equal parts of turpentine and copaiba; or tincture of iodine and soap-liniment. When the external surface is very tender, a good local application is formed by a mixture of two ounces of collodion, six drachms of Venice turpentine, and three drachms of castor-oil; or tender chilblains, that do not itch, may be covered over by adhesive plaster spread upon kid or chamois leather.

To relieve the itching, if it be excessive and unbearable, some resort to the expedient of rubbing the part with snow, or plunging the feet into cold water; while others find relief by putting the parts into hot water with a small quantity of mustard-flour in it.

It may happen that the daily attack of irritation occurs at some hour of the day most inconvenient to the sufferer;

perhaps interfering with his enjoyment when in society, or altogether deterring him from both business and pleasure during a certain period of the afternoon or evening. In such cases much discomfort may be avoided by artificially inducing the daily attack at an earlier and more convenient hour, and this may be done by keeping the feet for a short time in mustard and warm water. Vesicated chilblains may be protected by a coating of collodion and castor-oil varnish. For ulcers or sloughs resulting from chilblains, poultices smeared with turpentine, or resin cerate, or Peruvian balsam, may be applied until the slough separates, when the sore may be dressed with any of the above-named applications upon lint.

Diseases of the Nails.

Onychia maligna is a term applied to a specific form of ulceration commencing about the matrix of the finger-nails. The disease is almost confined to children under ten years of age, and is by no means of frequent occurrence. Among more than seven thousand surgical out-patients under twelve years of age, I have found the disease in nine instances only, and these cases occurred between the ages of one year and seven.

Onychia usually has its origin in a pinch or a crush of the finger-end, such as may either bruise the matrix or loosen the attachments of the nail. Soon after the injury, the finger-ends swell, and fluid is effused beneath the nail; which latter loses its natural colour, and becomes thin and flattened at the end, or more rarely curled up laterally. As it grows, it turns upwards from its normal attachment, and exposes beneath it an exceedingly foul and painful ulcer, having a peculiar and characteristic fœtor; while the finger-end becomes greatly enlarged and bulbous-looking, its integuments being hardened, shining, and of a livid red colour.

The disease seems little prone to spontaneous recovery; but may continue its progress until the last joint of the finger be lost, or the phalanx necrosed by extension of the ulceration.

The treatment consists, first, in the evulsion of the nail, if it be loose, displaced, or discoloured; subsequently the ulcerated surface may be dressed with black wash, or a lotion formed of one or two drachms of the liquor potassæ arsenitis to an ounce of water. The arsenical application appears to exercise some specific effect on onychia, and rarely fails. Such constitutional remedies as seem suitable to each case may at the same time be employed; and among these chlorate of potash, with bark, appears to be of use in many cases. Amputation has been occasionally practised as a cure for this disease, and a mercurial course has been recommended. The former is an unnecessary mutilation, and the latter is not required in the form of the disease described above.

There is a form of onychia having its origin in constitutional syphilis. It usually attacks the toe-nails, and is often associated with ulcerative fissures between the toes; 'rhagades digitorum,' as they were formerly termed. In this form of the disease the ulceration is generally less extensive, the surrounding swelling is not so considerable, and the nail is less seriously implicated; while the history of the patient, or the concurrence of some other symptom of syphilis, furnish evidence of the nature of the disease. Syphilitic onychia may be treated locally by the black or yellow wash; it being, of course, of primary importance to adopt appropriate anti-syphilitic measures.

Psoriasis may attack the nails, either those of the fingers or toes; and it is often, though not always, local evidence of constitutional syphilis. In this affection the central part of the nail becomes thickened, rough, and scabrous, and unnaturally convex; the free edge is often split; the cuticular fringe at the bottom of the nail is ragged and retracted, leaving a deep fissure between the nail and the skin of the finger. The whole nail, in an extreme case, resembles in miniature the outside of the concave shell of an oyster. The affection is chronic in its nature, and exceedingly difficult to cure. It is probable that the nails are liable to some of the vegetable parasitic affections of the skin, since Dr. Hilton Fagge has recently discovered in the nails of individuals suffering from ringworm, spores, resembling those of *Tinea Tonsurans.*[*]

In syphilitic psoriasis the administration of small doses of mercury continued over a long period is likely to prove beneficial; and in cases of non-syphilitic origin the most hopeful constitutional treatment is that by arsenic in combination with some tonic. The appearance of the nails may be much improved by smoothing them down with glass or fine sand-paper; or the roughness may for a time be removed by friction with dilute acetic acid; and at night-time the skin at the margins of the nails may be dressed with a mixture of white precipitate and tar-ointment.

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[*] *Pathological Society's Transactions,* vol. xxi. p. 407.

In-grown toe-nail, as the affection is usually termed, occurs, we believe, invariably on the outer side of the nail of the great toe. It is caused either by over-crowding the toes and thereby thrusting the soft parts over the margin of the nail, or by the toe-nail being cut away too deeply at the outer angle, allowing the soft parts to encroach on the proper limits of the nail; which latter, so soon as it again grows up from below, imbeds itself in the overlapping integument. The continued pressure causes considerable pain and inconvenience in walking, and if unrelieved often gives rise to a fungous growth of very sensitive granulations, which may cover the entire nail.

In the treatment of this affection it is of primary importance to secure a roomy covering for the foot. If the disease has been but a short time in progress, and has not produced any considerable mass of overhanging integument or fungous granulations, the pressure of the nail on the soft parts may be relieved by carefully packing into the cleft or groove on the affected side of the nail oiled cotton-wool in small shreds with the flat end of a probe or the edge of a pen-knife. This may be effected without causing any pain. The quantity of wool introduced may be gradually increased at each application, until the soft parts are raised and pushed aside, so as to expose the free edge of the nail, beneath which the wool should be inserted until the natural state of the parts is restored; when the nail should be allowed to grow up, so as to form a right angle at the outer corner. If there is much inflammation of the parts, the toe may be kept wrapped in water-dressing during the above described treatment; while the overhanging integument may be assisted to regain its natural relation to the nail by a strip of adhesive plaster applied to it, and drawn round beneath the toe, so as to exercise some traction on the part.

Another method of relieving the flesh from pressure in more severe cases is by scraping the in-grown side of the nail very thin with glass or the edge of a knife; or the free edge of the nail may be knotched, and a longitudinal division be made down to the matrix, by cutting with a knife from the surface, This will allow the partially detached strip, as it grows, gradually to overlap the body of the nail, and thus free the soft parts from pressure.

When, from neglect of remedial measures, the nail has penetrated deeply into the flesh, and there is either considerable ulceration or fungous granulations, the most successful treatment is to remove at once the offending portion of the nail. This may be done rapidly and almost painlessly, with the help of ether spray, by thrusting a strong pair of scissors beneath the nail, from its free edge down to the matrix, and tearing out the outer strip of nail with strong forceps. The same proceeding can be effected more gradually and with but little pain by those skilled in the practice, by dividing the nail with a knife from the surface towards the matrix, and then slowly separating the semi-detached portion from its deep connections.

The exuberant granulations which often form in this disease can be disposed of by dusting with the oxide of zinc, or by a lotion formed of the tincture of the sesquichloride of iron, or they may be destroyed with sulphate of copper or lunar caustic. Removal of the overhanging mass with a knife, though effectual, somewhat prolongs the healing. It has been recommended to treat this affection by the introduction of a thin strip of sheet-lead beneath the margin of the nail. The lead should be bent so as to pass round beneath the toe towards the inner side of the foot. This plan is somewhat difficult to carry out, on account of the pain it is liable to occasion.

THOMAS SMITH.

ANÆSTHETICS.*

TO prevent or diminish pain in surgical operations is an object so desirable, that many in various ages in the history of Medicine have sought to attain it, either by means of narcotic drugs designed to act on the body generally, or by compressing or otherwise locally affecting the nerves of the part concerned.†

The first really valuable suggestion, however, was made in the year 1800 by Sir Humphry Davy, who, having himself experienced relief from pain when breathing nitrous oxide gas, threw out the hint that it might probably be employed with advantage to produce a similar effect in surgical practice.‡

The same idea occurred, after the lapse of nearly half a century, to Dr. Horace Wells, a dentist in Hartford, Connecticut, who, in 1844, underwent the extraction of a tooth without pain after inhaling the gas, and gave it with satisfactory results to several of his patients; but he soon after found the practice so uncertain that he abandoned it entirely. §

About the same period, Dr. W. T. G. Morton, of Boston, in America, who had previously been a partner with Wells, but did not, as he informs us, receive any suggestion from him, became possessed with the desire of discovering an efficient anæsthetic, and commenced a series of experiments upon himself and the lower animals, which at last resulted in his extracting a tooth painlessly from a patient, to whom he had administered the vapour of sulphuric ether by inhalation. This was on September 30th, 1846.* Soon afterwards he publicly exhibited his method at the Massachusetts General Hospital; and thenceforward anæsthesia in surgery was an established blessing to mankind.

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* In revising this article for the 2nd edition, I have thought it best to leave it essentially unchanged, and append to it such observations as have been suggested by the experience of the time which has elapsed since the first publication. See p. 496.

† For much curious information regarding the history of this subject the reader is referred to the work of the late Dr. Snow on *Anæsthetics.*

‡ *Chemical Researches*, p. 556.

§ *Statements of William T. G. Morton, M.D., on his claim to the Discovery of the Anæsthetic Properties of Ether, &c.*, Washington, 1853, pp. 42, &c.

Sulphuric ether is still extensively used as an anæsthetic in America; but in Europe chloroform is generally preferred to it. Disguised under the name 'chloric ether,' in which it exists diluted with spirit of wine, this agent was the subject of Dr. Morton's first experiment upon himself; † and it was used in the same form at St. Bartholomew's Hospital, in preference to sulphuric ether, by Mr. Lawrence in the summer of 1847.‡ In the autumn of that year Dr., afterwards Sir James Y., Simpson, who was engaged in a series of experiments with various narcotic vapours, employed for the first time the active principle of chloric ether, at the suggestion of Mr. Waldie, of the Apothecaries' Hall of Liverpool; § and finding that the pure chloroform was more potent than sulphuric ether, yet caused less bronchial irritation, while its odour was more agreeable and its inferior volatility rendered its exhibition more easy, || he zealously recommended it to the profession, and it has since been generally employed throughout Europe.

The effects produced by chloroform are such as to fit it remarkably for the purposes of the surgeon. Like most narcotics, it tends to cause, after temporary excitement, suspension of the functions of the nervous centres, but affects them not simultaneously, but in a certain order; and the brain is the first to show loss of power in failure of sensation and voluntary motion. If this were all, anæsthesia would be a questionable boon; as the work of the surgeon would be interrupted and often marred by involuntary struggles on the part of the patient. But very soon the spinal cord also is subdued, and the reflex functions of the cerebro-spinal axis are abolished so far as concerns the voluntary muscles, which consequently lie perfectly relaxed and

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* Dr. Morton's *Statements, &c.*, pp. 45, &c.

† Op. cit. pp. 45, 46.

‡ Snow on *Anæsthetics*, p. 20. That chloric ether was employed at St. Bartholomew's Hospital has been further confirmed by information kindly communicated to me by Mr. Paget.

§ Snow on *Anæsthetics*, pp. 21, 22; also Dr. Simpson's original pamphlet, *Account of a new Anæsthetic Agent*, &c. p. 6.

|| For operations performed by artificial light, chloroform has another advantage over ether, in the fact that its vapour is not inflammable.

passive, better suited for operative purposes than the most resolute will could render them. To this, however, there is one remarkable exception, viz. that the parts concerned in the respiratory movements remain active; and the same is the case with the sympathetic ganglia of the heart. In other words, when the administration of chloroform is carried to a certain point, the nervous system is deprived of such powers as would cause pain to the patient or inconvenience to the surgeon, but retains intact the faculties essential to life.

There are, however, yet other advantages derived from the inactivity of the cerebro-spinal centre. It seems now clearly established that the cessation of the contractions of the heart in the shock of injury depends upon an action of the brain and cord upon the cardiac ganglia through the medium of the vagus and sympathetic nerves; and chloroform, rendering this action impossible, protects the heart from the indirect effect of external violence. In this way it has greatly diminished the risk of death upon the operating table, and also has overthrown the old rule of deferring amputation in cases of injury till the patient has recovered from the state of collapse; thus shortening the period of mischief to the system from the presence of the mangled limb, and in extreme cases sometimes saving life where it would be hopeless to wait for returning consciousness. Indeed, an amputation performed under chloroform has often the effect of improving instead of lowering the pulse.

The most striking instance of this, that has fallen under my notice, occurred in a labourer, whose right arm and thigh had been destroyed by a railway accident, just enough sound tissue being left to admit of amputation through the hip and shoulder joints, which was accordingly performed as a forlorn hope by the surgeon in charge of the case. The vital powers being in a state of extreme depression, it is probable that without chloroform this severe measure would have killed him outright, but by help of the anæsthetic it was followed by marked improvement of the pulse, which continued for some hours, so as to lead us to entertain hopes of his recovery.

Faintness during the operation, a species of shock, is also got rid of by chloroform; and this, besides its obvious convenience, has the advantage of lessening the chance of secondary hæmorrhage; for the vessels which require ligature declare themselves as such by bleeding, instead of deceptively eluding observation in consequence of the feebleness of the heart and the general arterial contraction which coexist in the state of syncope.

The welfare of the patient is besides greatly promoted by the mental tranquillity arising from the prospect of immunity from suffering, which also induces persons to submit much more readily to the necessary operations, and often to undergo without hesitation treatment which was formerly impracticable because intolerable.

Such being the great benefits conferred by this agent, it is melancholy to reflect that in many parts of Europe, and even of the United Kingdom, it is either withheld altogether or given so scantily as to be nearly useless. This arises from fear, inspired by several fatal cases that have occurred. But when I state that Mr. Syme has given chloroform about five thousand times without ever meeting with a death, and that Sir J. Simpson's experience, also very extensive, has, so far as I am aware, been equally satisfactory, it is clear that it may be used so as to be practically free from any risk whatever.

How then are the fatal cases to be accounted for? Heart-disease has been supposed to be a common cause of them; and it is a prevalent opinion that it is highly dangerous to administer chloroform to persons affected with cardiac disorder.

It happens that the only death I ever witnessed under chloroform occurred in a person whose heart proved, on examination, to be extensively affected with fatty degeneration, such as would be regarded as sufficient explanation of sudden death under any circumstances. The particulars of this case, however, presented peculiar features, which lead me to take a different view of the part played by the chloroform from what might at first be assumed. The patient was a man above the middle period of life, affected with cancer of the penis, for which amputation of the organ was to be performed. The gentleman in charge of the chloroform, considering the momentary nature of the operation, purposely abstained from giving it as fully as usual, and had removed the cloth containing it from the face before the operation was commenced. The surgeon now placed his finger on the patient's wrist, and, having ascertained that the pulse was good, at once effected the amputation almost instantaneously. I observed that the passage of the knife through the member was accompanied by a start of the patient's body; the bandage used to control the bleeding was then removed, but no blood flowed from the arteries; he was found to have no pulse at the wrist; in short, he was dead. From these facts we can hardly doubt that death was a consequence of the shock of the operation acting on a diseased heart; and the only question is whether the circumstance that he had taken chloroform promoted that result. From the foregoing considerations, such a thing seems altogether improbable, as we have seen that chloroform protects the heart from the effect of shock. The fact that the patient started proved that reflex action was not abolished in the voluntary muscles, and confirmed the statement of the administrator that the chloroform was imperfectly given. My own impression is, that if it had been pushed to the usual degree, the fatal occurrence would have been averted.

I have given this case in detail because I believe it may be regarded as typical of a considerable class in which death has taken place suddenly at the commencement of an operation with imperfect administration of chloroform, which stands to the fatal event in the relation of an accidental concomitant, or rather a preventive insufficiently used.*

A death essentially similar, though more obviously unconnected with chloroform, took place on the occasion when it was intended to have administered it for the first time in the Edinburgh Infirmary; but Dr. Simpson being prevented from attending, the operation was commenced without the anæsthetic, and the patient died suddenly immediately after the first incision. It has been often remarked, that if the original intention had been carried out, chloroform would never have been heard of again in Edinburgh; but it is very likely that the man might then have lived to testify to its benefits.

There is another class of fatal cases in which the use of chloroform seems to have been simply a coincidence, the real cause of death being mental emotion, acting usually upon a disordered heart.

Dr. Snow mentions a distinct example of this, where a mere profession of administering chloroform was made, and the patient died of fright; † and I am able to give, from Edinburgh experience, an instance in which chloroform was still more remotely concerned. The late Dr. Richard Mackenzie being called to see a gentleman who had fractured his radius, had some thought of employing chloroform in examining the arm, but, changing his mind, made the necessary manipulations without it. He then proceeded to leave the house; but had not got down the steps leading from the door when he was called back with the announcement that his patient had suddenly expired.

Had chloroform been held near the face a few seconds before this occurrence, it would certainly have been blamed, though with manifest unfairness; and a similar injustice seems to have been committed with regard to several cases in which fatal syncope has taken place early in the administration of the anæsthetic, when the brief period of inhalation concurred with the symptoms in showing that the patient was little, if at all, under its influence. A fear of the chloroform itself seems to have been the exciting cause in some of these cases; and one reason why no such instance has occurred in the Edinburgh Infirmary is probably the unlimited confidence reposed in this agent by the inmates of that institution.

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* An observation made several years ago by Mr. Bickersteth, of Liverpool, has an interesting bearing upon this class of cases. He noticed on three occasions in amputation of the thigh that the pulse stopped suddenly at the moment the knife entered the limb, but recovered itself in a few seconds. The patients were under the influence of chloroform; but as Mr. Bickersteth never observed the same thing again, though he watched the pulse carefully at the same period in a great number of capital operations under chloroform, it seems probable that the anæsthetic was not administered to its full degree in those instances. (See *Monthly Journal of Medical Science*, September 1853.)

† Snow on *Anæsthetics*, p. 201.

It might, perhaps, have been expected *à priori* that chloroform, in the early or exciting stage of its operation, would act upon a diseased heart like mental emotion, and cause irregularity or cessation of its contractions. This, however, does not seem to be the case; and, judging from my own experience, I should say that it tends rather to remove intermission or irregularity of the pulse. On the whole I believe that chloroform, by preventing shock and mental effort during the operation as well as anxiety before it, is in reality a great source of safety in heart-disease; and that if a person with known cardiac affection decides to place himself in the hands of the surgeon, so far from being unsuited for the anæsthetic, he is before all others the man who stands most in need of its protecting influence.

Nevertheless, even when the heart is perfectly healthy, it is quite possible to administer chloroform so as to produce a directly sedative and deadly influence upon the cardiac ganglia. This truth was deeply impressed upon me eight years ago by the following occurrence.

An eminent London physician, desirous of making some experiments upon the heart, selected a young donkey for the purpose, and requested me to maintain artificial respiration, which was done by means of a large pair of bellows connected with a tube tied into the trachea, the animal having been previously put under the influence of chloroform. The chest having been opened, the investigation was continued for a while, when the creature began to exhibit signs of returning consciousness. To avert this I removed the bellows, and poured into them a considerable quantity of chloroform, and resumed the artificial respiration with energy for a short time, the natural respiratory movements meanwhile continuing; when suddenly the heart, which lay exposed before us, ceased to beat, and refused to contract again even when its muscular substance was pinched, which showed that its nervous apparatus was paralysed.

This was no doubt caused by the air becoming highly charged with chloroform in passing over the extensive evaporating surface presented by the interior of the bellows. For it had been before shown by Dr. Snow, from experiments upon the lower animals, that an atmosphere containing more than a certain percentage of the narcotic vapour stops the heart before breathing ceases; whereas the reverse occurs when the chloroform is more diluted with air.* Hence, with the view of preventing fatal syncope, Dr. Snow contrived an inhaler for regulating the amount of chloroform vapour in the inspired air; and used it in upwards of four thousand cases, of which only one was fatal, and even that seemed to be so independently of the chloroform. Finding his ingenious efforts crowned with such success, and charitably supposing that all were as careful as himself, he concluded that fatal cases in the hands of others could result only from a faulty method of administration; and assuming that when chloroform is given from a folded cloth it is apt to be in too concentrated a form, he attributed most of the deaths that have occurred to paralysis of the heart from this cause.

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* I have noticed, however, that different animals differ in their susceptibility to chloroform. Thus, frogs or mice may be kept for any length of time under

But the cloth being the means which has been used from the first in Edinburgh, with success even superior to Dr. Snow's, I have been long satisfied that his argument was fallacious; yet as his special devotion to the subject, and the valuable facts which he has communicated regarding it, render his opinion influential, I have thought it worth while to subject a matter of such great practical importance to experimental inquiry; and, about the usual quantity of the liquid being employed, I find that, so far from the amount of chloroform given off from the cloth being in dangerous proportion to the air inhaled, the whole quantity which evaporates from the under surface, even when the rate is most rapid, viz. just after the liquid has been poured upon it, is below Dr. Snow's limit of perfect security against primary failure of the heart.*

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its influence; but bats are very apt to die when treated in exactly the same way.

* The experiments were performed in the following manner. A cloth, similar in all respects to what would be used in practice, was supported upon a light wire frame-work, and suspended at a little distance from the floor by a thread, connected with one end of the beam of a balance, projecting over the edge of the table on which it stood. The weight of the cloth having been ascertained, a weighed quantity of chloroform, corresponding to fl. ʒjss., which is about the amount commonly used, was poured upon the middle of the lower surface of the cloth, which was then allowed to hang close above my face, so that I might breathe fully upon it, while inspiration was performed through a long India-rubber tube to avoid inhaling the chloroform vapour. The amount lost by the cloth was indicated by the weights in the scale at the other end of the beam. At the commencement of an experiment the weight was made a few grains less than the sum of the weights of the cloth and chloroform together, and an assistant noted the second when the scale with the weights in it came to preponderate; then removed ten grains so as to allow the scale to rise, and again watched the time of its descent; and repeated this process several times,

But, considering the great diffusibility of the vapour, and the large amount blown away in expiration, it is evident that only a small proportion of that which comes from the lower surface of the cloth really enters the lungs. Were it otherwise, it would be extremely dangerous to give chloroform with the cloth to infants; for as they inhale but a small amount of air, they would then breathe the vapour in a very concentrated state; yet all are agreed that infants are peculiarly favourable subjects for chloroform. In truth, the quantity dissipated into the surrounding air when the cloth is used involves considerable wastefulness in this means of administration, which is its only disadvantage as compared with an inhaler; but this is abundantly compensated by its greater simplicity, and consequent greater safety. For any apparatus which has the effect of preventing the free access of the atmosphere must be liable to operate in the same deadly manner as the

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thus obtaining a very accurate record of the rate of alteration in the weight. The lower surface of the cloth, which was made slightly concave, was circumstanced just as in the early period of the administration of chloroform, except that the inspired air was drawn from a distance. Inspiration does not, however, materially affect the rate of evaporation, as was found by experimenting with a cloth arranged above the mouth of a tube into which air was drawn by an appropriate apparatus. Allowance being made for the slight gain in weight that the cloth would obtain from absorbing moisture from the breath, the amount of chloroform lost from both surfaces together was thus easily determined. In order to ascertain how much escaped from the upper surface, experiments were made with the same cloth, having first the upper and then the under side securely covered with oil-silk, the arrangements being as above described, except that my face was not below the cloth. The quantity given off from the upper surface in a normal atmosphere was thus determined; and this being subtracted from the whole loss from both surfaces under the circumstances of inhalation, gave the amount that evaporated from the lower surface only. At the temperature of 70° F., this proved to be, from the average of several experiments, about at the rate of 24 grains per minute during the first half minute; and allowing, with Dr. Snow, that 20 grains of chloroform correspond to 15·3 cubic inches of the vapour, and that 400 cubic inches of air are inhaled in a minute, we get 4·5 per cent as the proportion of the chloroform to the inspired air, on the hypothesis that all that evaporates from the lower surface enters the lungs; 5 per cent being what Dr. Snow was led by his experiments to regard as the proportion at which the respiration was quite sure to fail before the circulation, and that at which he aimed with his inhaler (op. cit. p. 84). On the other hand, Dr. Snow assumed that, when the cloth is used at a temperature of 70° F., 9·5 per cent of chloroform is really inhaled (op. cit. p. 34); whereas, in truth, of the 4·5 per cent a large amount is dissipated into the surrounding air.

bellows in the case above related; and even when constructed upon the best principles, it will require most careful management, as is admitted by Dr. Snow with regard to his own inhaler.* On the other hand, there can be no mistake about the manner of using the cloth, which is also always at hand under all circumstances.

The theory of syncope from too great strength of the anæsthetic vapour when the cloth is employed being erroneous, the greater number of the deaths still remain unaccounted for; and, if we except a very few instances for which we seem to have nothing to fall back upon but an idiosyncrasy so rare that it may practically be left out of consideration altogether, their explanation will, I believe, be found in an overdose of this potent narcotic from too long-continued administration.

This is what might be expected from a general view of the statistics. Were we to ask ourselves in what sort of operations we should have anticipated most frequent deaths during the employment of chloroform, we should say in those which are likely to inspire great dread on account of their magnitude and severity, and to cause great shock and great hæmorrhage. More especially should these preponderate among fatal cases in general hospitals, where serious operations constitute the majority of those performed. The reverse of this, however, is what we actually find. Of the whole number of cases recorded by Dr. Snow in 1858, as due to the use of chloroform throughout the world during ten years, nine only occurred in any considerable surgical procedure at a general hospital; remarkably few, considering the enormous number of important operations that must have been performed during so long a period, and the variety in the qualifications of those who administered the chloroform. On the other hand, fourteen took place at similar institutions in connection with the most trivial matters, such as the removal of a toe-nail, the amputation of a finger, the passing of a catheter, or the cauterising of a wart. The only rational explanation of this seems to be, that when some great operation is to be performed, like the amputation of a thigh or the removal of a stone from the bladder, plenty of well-qualified assistants are present, and each of them, including the giver of the chloroform, is duly impressed with the importance of his office, and bestows the requisite pains upon it. But when some trifle is to be done, the whole affair is apt to be regarded too lightly, and the administration of the anæsthetic is perhaps confided to some unsuitable person, who also allows his attention to be distracted by other matters. This conclusion is entirely in accordance with my own experience, which, while it has convinced me more and more of the safety of chloroform if properly given, has impressed me deeply with the necessity for more vigilant care in its employment than is sometimes apt to be bestowed.

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* Op. cit. pp. 181, 188.

But an overdose of chloroform may be caused by attention misapplied, as well as by want of attention. The requisites for safety in using it will be best introduced by a short account of what ordinarily occurs in the mode of administration with which I am most familiar. A common towel being arranged so as to form a square cloth of six folds, enough chloroform is poured upon it to moisten a surface in the middle about as large as the palm of the hand, the precise quantity used being a matter of no consequence whatever. The patient having been directed to loosen any tight band round the neck, and to shut his eyes to protect them from the irritating vapour, the cloth is held as near the face as can be comfortably borne, more chloroform being added occasionally as may be necessary. After a time, varying considerably in different individuals, but generally longest in adults who have been accustomed to the free use of narcotics, and shortest in young children,* signs of excitement begin to manifest themselves in various ejaculations and muscular efforts, which soon give place to a state of complete repose. The struggles of the patient are sometimes so violent as to require considerable force to restrain them; and, for this reason, at least one efficient assistant should always be in attendance. On the other hand, I have seen chloroform induce nothing but a tranquil slumber; and it is important to bear in mind that the stage of excitement cannot be reckoned on as invariably declaring itself at all.

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* I once met with an instance in which chloroform seemed incapable of affecting a patient. It occurred in the private practice of Mr. Syme, who was about to perform an operation, for which we proceeded to administer the anæsthetic; but after we had used the cloth till we were tired without any apparent effect, Mr. Syme went on with the operation while the patient was conscious. Such a case is, no doubt, excessively rare; but it is interesting as giving some colour to the hypothesis, that idiosyncrasy in the opposite direction has existed in some very few fatal cases, which seem to admit of no other explanation, as alluded to in the text.

The most convenient test of the patient being prepared for undergoing the operation is presented by the eye; not in the size of the pupil, which is inconstant in its indications, but in what is commonly spoken of as insensibility of the conjunctiva; though in truth it has no relation to sensation, which is abolished considerably earlier; but when unconscious winking no longer occurs on the eye-ball being touched with the tip of the finger, we have a good criterion of the suspension of reflex action in the body generally. At this period the pulse is in about a normal condition, and the respiration is usually either natural or very slightly stertorous, though persons with a strong tendency to snore may do so almost from the commencement of inhalation. But if the administration of the chloroform be further persisted in, strongly stertorous breathing will soon be induced, and will become aggravated till it passes into complete obstruction to the entrance of air into the chest, though the respiratory movements of the thoracic walls still continue. Occasionally, however, the premonitory stertor is deficient, and the breathing becomes more or less suddenly obstructed. This is a point of great importance; for without close attention it may escape notice, when the patient will be placed in imminent peril. For though the respiration may be resumed spontaneously, this cannot be relied on, and it would seem that when chloroform is given in an overdose, the cardiac ganglia are apt to become enfeebled; and on this account asphyxia produces more rapidly fatal effects under its influence than in ordinary circumstances. But if the obstructed state of the breathing is noticed as soon as it occurs, and the cloth is immediately removed from the face, and the tip of the tongue seized with a pair of artery forceps * and drawn firmly forwards, the respiration at once proceeds with perfect freedom, the incipient lividity of the face is dispelled, and all is well.

I am anxious to direct particular attention to the drawing out of the tongue, because I am satisfied that several lives have

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* The artery forceps are the most convenient means of drawing the tongue forwards. The puncture which they inflict is of no consequence; the patient, if he notices it at all, supposes that he has bitten his tongue when under the chloroform.

been sacrificed for want of it. In order that it may be effectual, firm traction is essential. I have, more than once, seen a person holding the end of the organ considerably beyond the lips without any good effect, and, placing my hand on his, have given an additional pull, that has re-established the respiration.

A simple experiment, which any one may perform upon himself, is illustrative of this point. Stertorous breathing, such as occurs under chloroform, may be produced at will, and may be carried on even while the tongue is protruded to the extreme degree. But if the tongue is laid hold of with a handkerchief and pulled so as to cause decided uneasiness, stertorous breathing of any kind becomes impossible. That further traction, when extension already exists to the utmost, should produce such an effect is an apparent anomaly, which it seemed important to explain. On investigating the subject, I noticed in the first place that stertorous breathing is of two essentially different kinds; of which one, that may be called *palatine*, consists in vibrations of the velum, and has either a buccal or nasal character, according as the air passes through the mouth or the nose; while the other, which is the profound stertor essentially concerned with chloroform, depends on a cause seated further down the throat, and, for reasons to be given immediately, may be termed *laryngeal*. By digital examination of my own throat, I found that the latter variety, and the complete obstruction into which it passes, could still be produced when the tongue was separated by a considerable interval from the back of the pharynx, while a free passage for the air existed onwards to the lips; which showed that the general belief, that the obstruction depends on a 'falling back of the tongue,' is erroneous. Also the epiglottis, instead of being folded back during the obstruction, as some have supposed, had its anterior edge directed forwards, and though it was thrown into vibrations when the stertor was strongest, it was evident that the cause of the sound was more deeply placed. I also found that, although firm traction upon the tongue abolished the obstruction and the stertor, it did not appear to produce the slightest change in the position of the base of the tongue; nor did it move the os hyoides upon the thyroid cartilage, as examined from without. Hence I was led to conclude that the beneficial effect of this procedure could not be explained mechanically, but must be developed in a reflex manner through the medium of the nervous system. The fact that, when sensation is perfect, some degree of pain is caused in the process, implying an irritation of the nerves, was in favour of this view; while the general abolition of reflex action by chloroform did not seem strongly opposed to it, considering that the reflex respiratory movements, including those of the glottis, go on in a person under the influence of chloroform.

For further elucidation of the matter, I had recourse to the laryngoscope; and, after a little patience, found no difficulty in inspecting my own vocal apparatus without employing any depresser of the tongue; using simply the small oblique long-handled speculum and a common mirror in bright sunlight. I then ascertained that the true laryngeal stertor results from the vibration of the portions of mucous membrane surmounting the apices of the arytænoid cartilages, *i.e.* the posterior parts of the arytæno-epiglottidean folds (thick and pulpy in the dead body, but much more so when their vessels are full of blood), which are carried forwards to touch the base of the epiglottis during the stertorous breathing, and are placed in still closer apposition with it when the obstruction becomes complete. Having one hand at liberty, I was able to observe the effect of drawing forward the tongue under these circumstances, and I saw that firm traction induced the obstructing portions of mucous membrane in contact with the epiglottis to retire from it for about an eighth of an inch, so as to allow free passage for the air, while the epiglottis itself was not moved forwards in the slightest degree.*

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* While the true laryngeal stertor was thus produced and thus removed, a sort of spurious snoring might be made by approximation of the vocal cords; but this spurious stertor was, like the voice, quite unaffected by drawing out the tongue. These observations were made on September 21st of the present year (1861). I find that there are four ways in which the passage through the larynx may be closed. First, the folding back of the epiglottis over the opening into the pharynx, as is generally believed to take place in swallowing, and may be demonstrated by arresting an act of deglutition in its progress, and insinuating the finger between the tongue and the roof of the mouth to the epiglottis, which is then felt to be turned backwards, and to return to its usual position as the act of deglutition is finished. Second, an approximation of the *sides* of the superior orifice of the larynx, in which the epiglottis is directed forwards, but folded longitudinally, so that its edges are in contact with one another while the arytæno-epiglottidean folds are also in lateral apposition. This occurs in retching, and doubtless also in vomiting, when a folding back of the epiglottis, instead of protecting the larynx, would tend to direct into it the material passing from below upwards. Thirdly, an *antero-posterior* coaptation of the structures of the laryngeal aperture at a somewhat deeper level, without any

Whether pulling the tongue operates by inducing or relaxing muscular contraction in the larynx, may be matter for discussion; but the main conclusion, that it does not act merely mechanically, but through the nervous system, appears satisfactorily established. I have not hesitated to give the evidence on which it rests in full, as it appears to me to be of the highest practical moment. For it shows at once how grievous a mistake is committed by those who content themselves with gently drawing the apex of the tongue a little beyond the teeth, or pushing forward its base with the finger, or perhaps ascertaining that the epiglottis is not folded back. Such proceedings are instances of attention misapplied, and waste the golden opportunity for rescuing the patient from death. The proper treatment, like many other good things in medical practice, owes its origin to a false theory; but though the erroneous notion of obstruction by the tongue did good service in the first instance by suggesting the original method, it now tends to encourage supposed improvements upon it, which rob it entirely of its efficacy.

If the above description is correct; if it is true that when the administration of chloroform with the cloth is carried too far, the first serious symptom is an obstructed state of the respiration, which without watchful care may occur unnoticed, and, if allowed to continue, will endanger the life of the patient, but, if promptly treated, will harmlessly disappear,—it follows that the attention of the administrator ought to be concentrated on the breathing, instead of being, as it too often is, diverted by the pulse, the pupil, or other matters still less relevant.

As an example of the risk that is run by want of close attention to the respiration, I may mention the following case. A surgeon of considerable experience was giving chloroform to a patient on whom an operation was being performed, of which I was a mere spectator; but I noticed that stertorous breathing came on, and gradually passed into complete obstruction, at a time

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change in the position or form of the epiglottis, towards which the folds of mucous membrane above the apices of the arytænoid cartilages are carried forwards, till they are in contact with its base. This is seen in coughing, and also in laryngeal stertor; and it is probable that during sleep, when the respiration is so apt to become stertorous, there is but a very narrow chink between the epiglottis and these folds of mucous membrane, which would thus serve to protect the deeper parts of the air-passages from the introduction of foreign matters in the state of unconsciousness. Fourthly, the closure of the *rima glottidis* in the production of voice. The white *chordæ vocales* form a beautiful contrast with the highly vascular structures in their vicinity.

when the administrator was gazing with interest upon the proceedings of the operator. Seeing that the patient was in danger, I suggested to the giver of the chloroform the propriety of pulling forward the tongue. He replied that this was uncalled for, and pointed to the heavings of the chest as evidence that breathing was proceeding freely. Knowing from what had gone before that those efforts were doing nothing for the respiratory function, and feeling that there was no time for discussion, I stepped out of my province so far as to seize the tongue myself and draw it forward, when a long and loudly stertorous inspiration demonstrated the necessity for the interference. Had the delusive movements of the chest been trusted, it is probable that they might have continued till the heart had become so enfeebled by the asphyxial state as to cause no perceptible pulse at the wrist: and had death occurred under these circumstances, the case would have been set down as one in which the circulation failed before the respiration. The administrator would thus have been absolved from all blame; and the fatal event would have been attributed to idiosyncrasy, or to any heart disease which might have been discovered on *post-mortem* inspection.

The very prevalent opinion that the pulse is the most important symptom in the administration of chloroform is certainly a most serious mistake. As a general rule, the safety of the patient will be most promoted by disregarding it altogether, so that the attention may be devoted exclusively to the breathing. The chance of the existence of heart-disease may seem to make this practice dangerous; but having followed it myself with increasing confidence for the last eight years, and knowing that it has been pursued all along by Mr. Syme, who has also acted on the maxim that every case for operation is a case for chloroform, and must, therefore, have given it to very many patients in whom cardiac disorder existed unknown to him, besides some in whom its presence had been ascertained, I feel no hesitation in recommending it. Even when serious disease of the heart is known to exist, it must be remembered that there is much less risk of syncope than of obstruction to the respiration; and while the latter will demand and repay immediate attention, the former, should it by any chance occur, being in all probability independent of any excess of chloroform, would not imperatively demand its discontinuance; nor would it be much influenced by treatment, supposing the patient to be already in the horizontal posture, which is generally considered safest in all cases when chloroform is given.*

From these considerations it appears that preliminary examination of the chest, often considered indispensable, is quite unnecessary, and more likely to induce the dreaded syncope, by alarming the patient, than to avert it.

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* From the views expressed in the text regarding the relation of syncope to the administration of chloroform, it might be inferred that no great danger would be incurred by giving it in the sitting posture when circumstances particularly require it; and accordingly Dr. Snow informs us that he has done

The obstructed state of the breathing, if allowed to continue long, would lead to a far more serious affection,—paralysis of the nervous centre concerned in the respiratory movements. Pulling out the tongue would then of course have no good effect of itself, but it should be done to clear the way for artificial respiration, which is the means to be essentially trusted to under such circumstances; and if the air still fail to enter freely into the chest, an opening ought to be made without delay through the crico-thyroid membrane. Cold water should also be occasionally dashed upon the face and chest; and if a galvanic battery happen to be in readiness, one of its poles may be applied over the spinous processes of the upper cervical vertebræ, and the other to the præcordial region, with the object of rousing the respiratory and cardiac ganglia. This, however, is a means not very likely to prove beneficial, and, if used in too intense a form, it may do harm instead of good.

Preparatory to taking chloroform the patient should be directed to omit the last meal which would naturally precede it, as any food in the stomach is almost sure to give rise to troublesome vomiting during the inhalation. The only after-treatment necessary is to allow the effects of the chloroform to pass off in a quiet sleep; and the only bad consequence likely to arise is a tendency to sickness, which sometimes causes annoyance during the first twenty-four hours or so.*

Chloroform is universally applicable in the various departments of surgery, except in some few cases in which the

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this on several occasions without any bad result. But considering the possibility of an overdose, and the feebleness of the heart which that seems to entail, it is no doubt wisest, as a general rule, to have the patient reclining. Dentists, it is true, give chloroform in the sitting posture; but so far as I have seen, they do not carry the administration beyond a slight degree, sufficient to deaden sensation without affecting reflex action, dexterously managing to open the mouth and operate upon it while the muscles of the jaws are rigid.

* It has been supposed by some that the use of chloroform increases the risk of pyæmia after capital operations; but experience has now abundantly proved the groundlessness of this apprehension. To take a single instance, the veins of the pelvic viscera being perhaps more liable than any others to originate phlebitis after surgical interference, lithotomy would be much more fatal now than formerly, were there any foundation in fact for the notion. The reverse, however, appears to be really the case. Thus, Mr. Cadge, one of the surgeons of the Norfolk and Norwich Hospital, an institution long celebrated for the

assistance of the patient is required, and in operations involving copious hæmorrhage into the mouth. Blood may trickle in small amount into the pharynx without risk of choking, deglutition being carried on unconsciously during anæsthesia; and even in some instances when the bleeding is more serious, as in removing portions of the jaws, pain may be avoided to a great extent by giving the chloroform during the more superficial parts of the operation, and allowing the patient to recover partially before undertaking its deeper stages.

The main conclusions arrived at in this article may be expressed in a few words. It appears that chloroform, though resembling many other valuable means of treatment, in being deadly when mismanaged, is free from danger if properly used; the following being the rules for its safe administration. A drachm or two of the liquid having been sprinkled upon the middle of a folded towel, hold it near the face, taking care that free space is afforded for the access of air beneath its edges, till the eyelids cease to move when the conjunctiva is touched with the finger. Meanwhile watch the breathing carefully; and if at any time it should become obstructed or strongly stertorous, suspend the administration and draw the tip of the tongue firmly forwards till the tendency to obstruction has disappeared.

These simple instructions may be acted on without difficulty by any intelligent medical man. The notion that extensive experience is required for the administration of chloroform is quite erroneous, and does great harm by weakening the confidence of the profession in this invaluable agent, and limiting the diffusion of its benefits.

The nine years which have passed since the above article was written have tended to confirm its main doctrines.

The safety of chloroform when administered according to the rules laid down in the preceding pages, has hitherto been verified without exception in my own personal experience; and I may add that Mr. Syme, though he continued to within the last two years in the full activity of his career as an operator,

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successful treatment of stone, in a district abounding in calculous disease, informs me that the mortality after lithotomy has been still further reduced there since the introduction of chloroform. (Recent statistics of lithotomy at the Norfolk and Norwich Hospital will be found in the essay on Lithotomy in Vol. IV.)

never lost a patient through its use, either in public or private practice. Further, I believe I am correct in stating that no case of death from chloroform has occurred during these nine years, in the operating theatre of either the Edinburgh or the Glasgow Infirmary, two of the largest surgical hospitals in Great Britain. Yet in both these institutions a folded towel, on which the anæsthetic liquid is poured, unmeasured and unstinted, is still the only apparatus employed in the administration: preliminary examination of the heart is never thought of, and during the inhalation the pulse is entirely disregarded; but vigilant attention is kept upon the respiration, and in case of its obstruction, firm traction upon the tongue is promptly resorted to. And it is worthy of special notice as showing that the success is due to soundness of the principles acted on, rather than any particular skill, that the giving of the chloroform, instead of being restricted to a medical man appointed for the function, as is elsewhere often thought essential, is entrusted to the junior officers of the hospital. In Edinburgh each of the five surgeons has two 'clerks,' intermediate in position between the house-surgeon and the dressers. They, besides other duties, take it in turn to administer the anæsthetic; and if I had to be placed under its influence, I would rather trust myself to one of these young gentlemen than to the great majority of 'qualified practitioners.'

The appointment of a special chloroform-giver to a hospital is not only entirely unnecessary, but has the great disadvantage of investing the administration of chloroform with an air of needless mystery, and withholding from the students the opportunity of being trained in an important duty, which any one of them may be at once called upon to discharge on commencing practice, and which, though certainly simple, is better performed after some practical initiation. I well remember the anxiety I felt on entering upon office as Mr. Syme's house surgeon, though I had before held a similar position in London, lest his first fatal case should occur in my hands; but this feeling soon gave place to perfect confidence, more especially after I had seen symptoms which would before have alarmed me, dispelled at once by traction on the tongue, which was then a novelty to me, and which is, I fear, even yet not duly appreciated by the profession generally.

An incident which occurred during my Glasgow incumbency illustrates so strikingly both the value of drawing forward the tongue, and the relations of the circulation and the respiration to chloroform, that it seems right to place it on record. One of my colleagues in the Infirmary had been making an attempt to reduce a dislocation by means of the pulleys, chloroform having been given very fully by the house surgeon, who, at the close of the performance, removed the cloth from the patient's face, and proceeded to attend to other matters. Happening to be present, and observing that the respiration was deeply stertorous, I watched it carefully, and noticed that it passed almost immediately into the state of complete obstruction, though still accompanied by the movements of the thorax, the face meanwhile becoming markedly livid. Unwilling to interfere and seeing the carotid pulsation conspicuous in the neck, I waited a while, hoping that the obstacle to the breathing would disappear spontaneously. But instead of this I soon saw to my horror the lividity give place to what I knew was physiologically identical with *post-mortem pallor.* I now rushed forward, and drew the tongue out firmly with the artery forceps, air at once passed into the chest and the man was rescued.

This case seems to me fraught with the deepest instruction. There can be no doubt that the patient was on the very verge of death; that if the laryngeal obstruction had lasted a very short time longer, the respiratory and cardiac ganglia would have failed in their functions. Supposing the administrator to have continued the chloroform with his attention devoted to the circulation, the first thing that would have alarmed him would have been the failure of the pulse at the wrist. On removing the cloth from the face, he would have seen the deadly pallor; and ignorant of the asphyxial lividity which had preceded, he would have taken it as positive evidence of primary failure of the heart; a verdict in which the whole profession would probably have supported him, whether valvular disease or fatty fibres could or could not be discovered on post-mortem inspection. The case, then, reads us another striking lesson on the paramount importance of taking the respiration as our guide, and shows how readily, if this be not done, a death due to the grossest mismanagement may be regarded as the inevitable result of constitutional peculiarity.

The case also shows the necessity of keeping watch for a while after the administration has been discontinued. The last portions of the vapour inhaled seem to take some seconds at least before they produce their full effects on the nervous centres; and the patient should not be left till he has been seen to breathe calmly and freely for some minutes after the cloth has been removed.

On one occasion only, so far as I remember, have I seen firm traction on the tongue fail to remove laryngeal obstruction. In that instance the chest continued to heave, but no air entered or escaped, although the tongue was well drawn out. Happily, however, the desired effect was instantly produced by slapping the face with a towel dipped in cold water, while the traction on the tongue was maintained. This fact is interesting, not only as a striking illustration of the value of the sudden application of cold under such circumstances, but also because it confirms the explanation before given of the *modus operandi* of traction on the tongue, viz., that it operates not mechanically, but through the nervous system. For here the barrier to the entrance of air into the chest remained in spite of the clearing away of any obstacle which the tongue might be supposed to present, but that barrier was at once removed by a means which could not act in any other way than through the nerves.

It is nevertheless true that the tongue does frequently fall back under chloroform, and so occasion a mechanical impediment to respiration. It recedes, no doubt, in consequence of relaxation of the lingual muscles; and accordingly thick or obstructed breathing depending on this cause may be very simply cleared by pulling the beard or a fold of skin below the chin, so as to draw forward the lower jaw, and act on the tongue through the medium of the muscular fibres which pass back to it from the maxilla. Turning the patient's face well round to one side, so as to cause the weight of the relaxed organ to tell laterally rather than backwards, is another way in which a needless puncture of the tongue may often be avoided. But it must always be borne in mind that neither of these means can be expected to succeed if the obstruction exists in the larynx, and if they do not answer their purpose, not a moment should be lost in applying the artery forceps.

Whenever it is necessary to draw the tongue forward, it is of course equally needful to suspend the administration, by taking the cloth entirely away from the neighbourhood of the face. To act otherwise would be to pour in a fatal dose after artificially removing the natural safeguard against its entrance. To give a caution against so obvious a breach of physiological principle may seem superfluous, but I know by experience that it is not uncalled for.

I have admitted in the foregoing article that idiosyncrasy may have been the cause of death in some anomalous cases which have been put on record. We certainly see strange varieties in the effects produced by chloroform both on the cerebral and the spinal centres. Some persons when inhaling it lie from first to last as in a tranquil slumber; some, before they succumb to its narcotic influence, struggle with great violence, without uttering a sound; others bawl lustily, while some sing sweetly, and others again are disposed to converse quietly though incoherently with those around them. There are also remarkable differences in the relation of sensation to consciousness under chloroform. As a general rule they are affected simultaneously, but we now and then see patients insensible to the pain of an operation, though perfectly conscious of all that is passing. Equally various are the effects upon the spinal functions. The absence of winking when the eyeball is touched with the finger, though a very good general guide to the abolition of reflex action in the body generally, is by no means an unvarying indication. In some persons that particular function is abolished earlier or later than usual. Relaxation of the sphincters of the bowel and bladder is a result of chloroform happily only occasionally met with, and various other instances of exceptional phenomena might be mentioned. Another example of peculiarity, more closely bearing upon the question of death from chloroform, has come under my observation in two instances during the last nine years, viz. cessation of the movements of the thorax, or in other words suspension of the function of the respiratory ganglia, without any preliminary laryngeal obstruction; although there was not, so far as I could judge, anything unusual in the mode of administration. In both cases natural breathing soon returned under artificial respiration maintained by intermitted pressure on the false ribs, while the tongue was drawn forward, accompanied by occasional slapping of the face and chest with a cold wet towel. But the condition was sufficiently alarming while it lasted. The patients were both elderly, feeble subjects: and I may remark that if I ever give chloroform with any degree of apprehension, it is to the aged and infirm.

Another closely allied instance of idiosyncrasy once presented itself in my practice. I had removed under chloroform a small epithelial cancer from the eye-brow of a feeble old woman, nothing unusual having occurred, when I noticed that the breathing assumed a peculiar sighing character, and the intervals between the sighs became greater and greater till I began to fear their entire cessation. However, normal respiration returned, and in the course of a few minutes she got up and sat in a chair beside the fire. But she had not been there long before the same strange slow breathing came on again, as if she would sigh her life away; and I believe that if I had not had her put back promptly to bed, she would actually have died. Here a feeble frame was further weakened by the potent narcotic, and it happened that the effect told especially upon the respiratory function, with the peculiarity that it was manifested not during the administration of the chloroform but subsequently.

With these examples before us of deviations from the usual order in which the various functions of the nervous system are affected by chloroform, no one can say it is impossible that here and there an individual may be found so constituted that, without any undue proportion of the narcotic vapour to the air inhaled, the cardiac ganglia may fail before the respiration is interfered with. But while freely admitting that such a thing is possible, I must repeat my firm conviction that this kind of idiosyncrasy is certainly 'so rare that it may practically be left out of consideration altogether.'

The danger of chloroform may be compared, not inaptly, to that of railway travelling. In both cases the risk incurred by any individual is so small that it does not enter seriously into our calculations. And just as railway accidents are generally occasioned by culpable mismanagement, so death from chloroform is *almost invariably* due to faulty administration.

Various attempts have been made during the last nine years to improve our anæsthetic methods. Among these must be mentioned the reassertion of the claims of sulphuric ether by the late Dr. Mason Warren of Boston, in America. Our transatlantic brethren naturally feel indignant that their grand discovery of anæsthesia in surgery should be confounded with the very secondary matter of finding out that a different agent from that which they employed will produce similar effects in a more efficient manner. For the introduction of chloroform when the whole subject was a novelty, led to a confusion in the public mind in this country, where 'the discovery of chloroform,' is often regarded as identical with the discovery of anæsthesia. And there can be no doubt that if sulphuric ether were still in use in Britain as it is in Boston, and if chloroform were now brought forward for the first time as a substitute for it, comparatively little would be thought of the innovation. More convenient chloroform undoubtedly is, on account of its smaller bulk, and the greater facility of its administration. But Dr. Warren contended that these advantages were more than counterbalanced by the greater safety of ether, which he declared had never up to the time of his writing produced a single death.* Admitting the facts to be in the main as Dr. Warren has given them, the case may probably be fairly stated by saying that ether, being less potent, is less liable to cause death from mismanagement. But the rules for the satisfactory use of chloroform are so simple that mismanagement is really inexcusable; and if we had nothing else to consider than the question of safety, chloroform would probably in all cases maintain its superiority over ether. There is, however, another point in which a great advantage has been lately claimed for the original anæsthetic. The vomiting which is so frequent after chloroform is generally only a matter of more or less inconvenience. But in the special case of ovariotomy the disturbance of the abdomen thus occasioned is often a cause of death. Dr. Thomas Keith, whose remarkable success in that operation is well known, was led to try sulphuric ether in the hope that it might prove less objectionable in this respect; and the result has been in the highest degree satisfactory, so that whereas with chloroform vomiting was the general rule, it now seldom occurs in his practice.† Dr. Keith has also ascertained that if truly anhydrous ether be employed, it can be given so as to produce its effect almost as rapidly as chloroform, and without waste of the material, by simply pouring a little of the liquid occasionally upon a piece of flannel contained in a cup-shaped vessel adapted to the mouth and nose, with a small aperture for the entrance and exit of air. Hence, as there are various other operations in which the avoidance of vomiting is a matter of great moment, sulphuric ether seems likely to reassume an important place as an anæsthetic.

Nitrous oxide, which we had looked upon as of mere historical interest, as a kind of pioneer in anæsthesia, has also been revived of late years and turned to practical account, chiefly through the exertions of Dr. Evans, an American dentist residing in Paris. It is a remarkable fact that, when inhaled unmixed with atmospheric air, it fails to produce the excitement to which it owes the name of 'laughing gas;' but merely throws the patient very rapidly into a condition of complete coma, attended with great lividity of the face, and staring dilatation of the pupils, presenting a very alarming appearance when seen for the first time, but, as experience shows, free from danger, subsiding as rapidly as it supervened, and leaving in the great majority of cases, no trace of sickness or other unpleasant effects. The agent has recently been rendered much more portable by keeping it stored in the liquid form in a strong cast-iron bottle, from which, by turning a stopcock, the gas is supplied to an india-rubber bag, large enough to contain about an average dose for producing insensibility. When this is exhausted the balloon can be refilled in the same way as often as may be desired, and thus it is possible by a series of intermitted administrations to keep a patient under the influence of the gas for a protracted period. It is questionable, however, whether nitrous oxide, if employed for producing long continued insensibility, would prove as safe as chloroform, and it is pretty generally admitted that its legitimate place is for operations of very short duration. But for avoiding the brief but acute agony of tooth-extraction, it appears to be an unquestionable boon to humanity.

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* See *Surgical Observations, with Cases and Operations*, by J. Mason Warren, M.D., &c.

† See *The Lancet*, August 20, 1870.

The benumbing influence of cold was brought into requisition several years ago by Dr. James Arnott for producing local anæsthesia, by means of a freezing mixture of pounded ice and common salt.* The same object has since been more efficiently attained by Dr. B. W. Richardson, by ingeniously availing himself of the reduction of temperature occasioned by evaporation. Anhydrous sulphuric ether intimately mingled with air in the form of spray is projected upon the part by means of a suitable apparatus easily worked by the hand. In a few seconds the skin upon which the spray plays suddenly assumes a snow white colour, implying that its surface is completely frozen. It is well to continue the application for a little while after this change has occurred, in order to ensure the penetration of the effect to a sufficient depth. The frozen parts may then be incised or operated on in any way that may be desirable, without the slightest pain to the patient, and the tissues when thawed are generally as well disposed for healing as usual.

This method is necessarily of limited application. It is only adapted for superficial operations, and even for many of these the rigidity of the tissues occasioned by congelation is inconsistent with efficiency of performance; as in removing epithelial cancers, where the sense of touch is the principal guide for the surgeon; or again in taking away thin-walled atheromatous cysts, where looseness of the surrounding cellular tissue is essential to satisfactory dissection. Nevertheless there are many cases, such as the incising of a boil or the removal of the nail of the great toe, in which this means of producing local anæsthesia proves perfectly satisfactory. In operating on the extremities I have found great advantage from restraining the circulation with a tourniquet, so as to prevent the oozing of hot blood, which would otherwise interfere with maintaining the frozen condition or extending it to deeper parts.

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* See *The Lancet*, October 30, 1858.

JOSEPH LISTER.

MINOR SURGERY.

THE following essay is not intended to embrace all matters usually included under the term 'Minor Surgery,' since many of these will be found scattered through this work, being treated of under the special diseases or particular localities with which they are more immediately connected. Nor does it attempt to enter into the minute details found in systematic works on minor surgery; but its aim is to describe briefly such proceedings in that branch of surgery as are for the most part general in their application to the several regions of the body, and are used in the treatment of many and various diseases.

BANDAGES, AND THEIR APPLICATION.

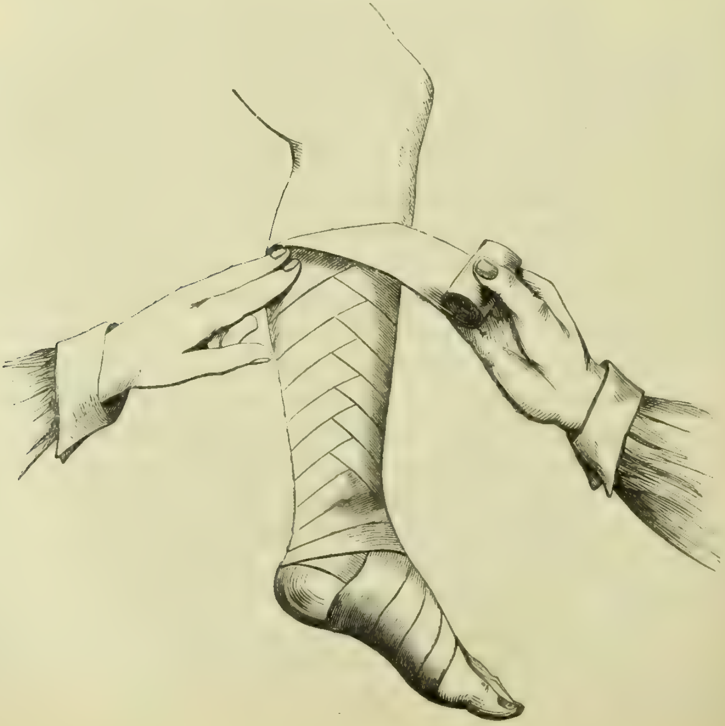
Bandages are appliances adapted, according to circumstances, to maintain uniform pressure on subjacent parts, to retain in position fractured or dislocated limbs, to assist in maintaining contact between the edges of large wounds, or to aid in the application of topical remedies to various parts of the body. For ordinary purposes they are made of linen or calico; in particular instances flannel, or some other elastic material, is employed, being torn into strips of appropriate length and width, and prepared for application by rolling up: these pass under the conventional name of rollers. Rollers may be single-headed, where the bandage is rolled up from one end alone, the other remaining free; or double-headed, where both ends of the bandage are rolled up each into a separate coil towards its centre.

To meet the varying requirements of various parts of the body, and to fulfil the diverse conditions for which they may be needed, ingenuity has devised a most extensive variety in the construction of bandages and in the manner of their application.

The more useful forms of bandage may, however, be included in two groups: (1) the simple or continuous; (2) the compound bandages. Under the term 'simple' may be included those in which a continuous roller is employed; these are the circular, spiral, figure-of-eight, and scalp bandage. Compound bandages are such as require more than a continuous roller for their proper adjustment; these may be enumerated as the many-tailed, the four-tailed, the suspensory, and the T-bandage, besides others which will not here be referred to, as their preparation and application belong to the province of the instrument-maker or bandagist.

Of simple bandages, by far the most useful and most general in its application is the spiral. It consists in a continuous spiral application of a roller, each succeeding fold overlapping the one that went before it by about one-third of its width; it is used on the fingers, the upper and lower extremities, the thorax, and abdomen. This form of bandage is in all cases applied from below upwards, or from the extremities towards the trunk. So long as the part to which it is applied is of uniform calibre, as the forearm for a short distance above the wrist, the bandage may be simply rolled around the limb, passing from left to right as it crosses the anterior aspect; but

Fig. 336.



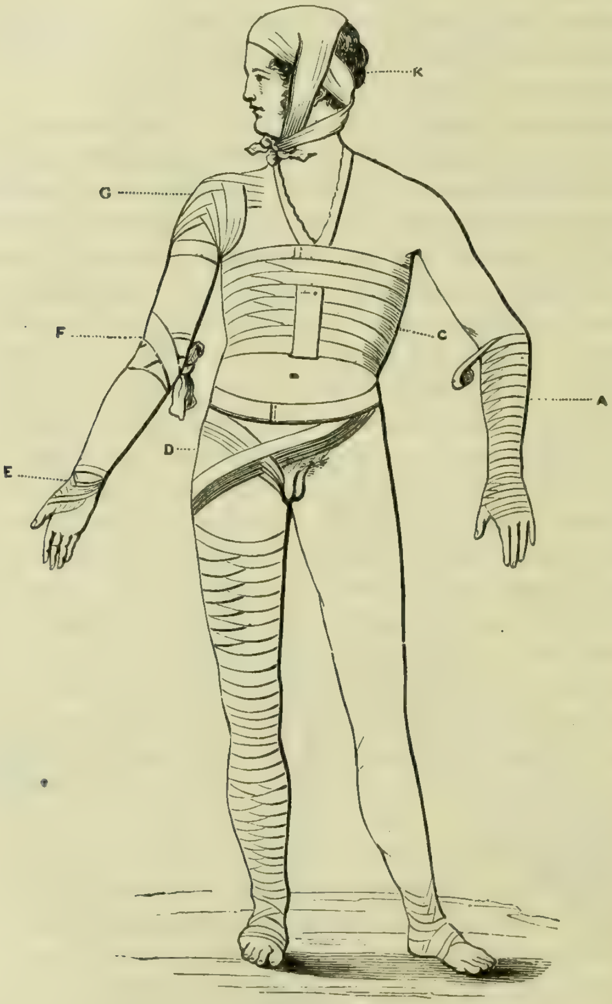
if the circumference of the limb gradually increase in size from below upwards, as the calf of the leg or upper part of the forearm, the bandage must be folded on itself in the manner represented in fig. 336. This proceeding should be effected at each turn of the roller, and should always take place opposite the same point in the circumference of the limb, or an unsightly appearance will be produced. Its effect is to distribute the pressure evenly over the surface of the part, and to obviate the risk of the bandage slipping. By referring to the adjoining woodcut (fig. 337), it may be seen at what parts of the body it is generally necessary to turn the bandage, in the manner above mentioned.

The spiral bandage is not well suited for passing smoothly over the angles of flexion or extension of joints, and for this reason the other variety of simple bandage, the figure of eight, is employed in conjunction with it in bandaging certain parts of the body. Thus to bandage the lower extremity, taking the head of the roller in the right hand and its free end in the left, the outside of this end should be laid on the dorsum of the foot and fixed by a turn or two of the roller. Passing over the limb from left to right, carefully keeping the bandage in a uniform state of tension, with as little of it unwound as possible, it may be now applied in a simple spiral manner, the roller changing hands each time it passes around the foot. The enlargement at the instep requires that the bandage be twisted on itself; over the ankle-joint it must be applied in a figure-of-eight fashion; again, at the lower part of the leg, it may be simply rolled around the limb, and higher up it must again be twisted on itself; and so on, varying in its method of application with the varying conformation of the part (fig. 336). It may be fastened off by pinning its end to the last fold applied; or the end may be split into two, and these, being carried in opposite directions around the limb, may be tied together where they meet.

The peculiar shape of the thorax, increasing as it does in circumference from below upwards, requires that a roller applied to that part, commencing from below, should be turned on itself as it ascends. Before applying a bandage to the thorax, a wide piece of roller, above five feet in length, should be split lengthways from its centre for about half a yard; this being thrown over the head of the patient, the ends may be allowed to hang down in front and behind. The patient standing with his back towards the surgeon, his hands raised above his head and resting against some support, the bandage may be applied over the neck-piece, beginning from below. It may be finally fastened off and secured from slipping in the manner represented in fig. 337, c.

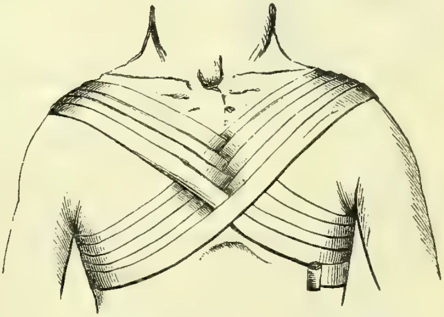
The figure-of-eight bandage is formed of a single continuous roller, and is admirably adapted for passing over the angles of the joints; and here indeed it is almost exclusively employed: as at the ankle, the knee, the groin, over the metacarpal articu-

FIG. 337.



lation of the thumb or finger, over the elbow-joint and shoulder. Again, it is made use of to keep the shoulders apart, or to draw them together, according as it crosses in front or behind the body. At the ankle the crossing of the bandage is so arranged as to fall in front of the ankle-joint, while the two circles of the figure embrace respectively the leg and foot (fig. 337). At the groin the two circles of the figure should surround, the one the upper part of the thigh, the other the pelvis; this form of bandage, under the name of spica, is generally applied after operations for strangulated hernia, the crossing of the roller being arranged so as to fall over the situation of the internal abdominal or femoral ring (fig. 337, D). In applying the figure-of-eight to the thumb, one limb of the figure should surround the root of the thumb, while the other passes around the wrist, the crossing of the bandage being situated over the subcutaneous margin of the metacarpal bone (fig. 337, E). At the elbow this form of bandage embraces the upper arm and forearm, and crossing over the flexure of the joint is thus made available for compressing the orifice of the vein after venesection as ordinarily performed (fig. 337, F). In bandaging the shoulder, the roller is passed around the upper part of the arm on the one side, and around the root of the neck, or under the opposite shoulder, on the other; the crossing of the bandage will thus lie over the prominence of the head of the humerus (fig. 337, G). The figure-of-eight, as employed for fractures of the clavicle, crosses over the situation of the spines of the upper dorsal vertebræ, and surrounds the shoulder-joints on either side, passing in front of them; when it is desirable to bring the shoulders forward and maintain them in this position, the bandage is arranged so as to cross over the front of the sternum and surround the shoulder-joints on either side, passing behind them (fig. 338). This form of bandage may be made available for compressing or supporting one or both breasts, being passed round the thorax under the affected breast and over the opposite shoulder. At the articulation of the knee the figure-of-eight is occasionally employed to bring together the

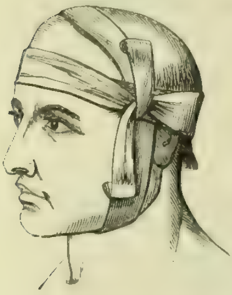
FIG. 338.



fragments of the patella after transverse fracture of that bone; for this purpose the circles of the figure must the one surround the leg, the other the thigh, the bandage being crossed in the popliteal space. For other purposes the bandage is reversed, and so applied that the crossing falls over the front of the articulation.

Of *scalp-bandages* there are two principal varieties, the knotted and the recurrent; they are employed for retaining local applications to wounds of the scalp, or for exercising pressure on the part to control hæmorrhage. The knotted bandage, which is generally employed for compressing the temporal artery, is applied in the following manner. A bandage, about two inches in width and four yards in length, being rolled up at either end into two separate and unequal portions, the surgeon taking one head of the roller in each hand, and standing facing the wounded artery, applies the unwound portion of the bandage over the compress. He should now pass his hands around the head, one on either side, so as to encircle it with the roller until he reaches the opposite temple, when the two heads of the bandage being crossed, they may be brought back again to the point of departure. Here, being crossed one over the other, their direction should be changed, one end being carried under the chin, the other over the vertex, so that they may again meet over the opposite temple, where they are again to be crossed and carried around the head, one on either side, to the point whence they first started. Here, again, they are crossed, carried respectively under the chin and over the vertex, and so on until sufficient compression is exercised over the wounded vessel. The application may be secured in position by a few circular turns of the long end of the roller (fig. 339).

FIG. 339.

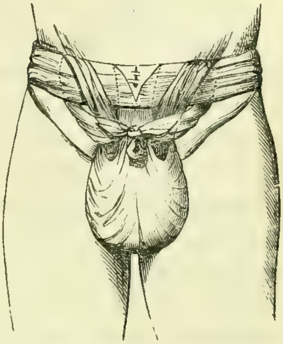


The recurrent or capeline bandage is difficult of application, and easily becomes displaced. As it is almost impossible to convey a proper idea of the manner in which it is adjusted by a mere verbal description, no further allusion will here be made to it.

Compound bandages.—The T-bandage, the four-tailed, the many-tailed, and the suspensory bandage, fall under this denomination. The T-bandage is formed of two pieces of linen roller attached to each other in the manner indicated by the name of the application. It is principally used in the neighbourhood of the perinæum, where it is well adapted to maintain pressure on the parts, or to retain in position any topical application.

In applying the bandage, that part of it represented by the horizontal limb of the T being passed around the body just above the crests of the ilia, should be fixed by tying together the ends in front of the belly, in such a position that the vertical part of the bandage shall be situated over the spines of the lumbar vertebræ; if the application is to be adjusted to a female, the loose end may now be brought forward between the nates and in front of the vulva, and attached to the horizontal portion in the median line of the abdomen. If the patient is of the opposite sex, the vertical part of the bandage should be split at its free end, and the two ends brought up one on either side the scrotum and penis to be attached to the part of the bandage that encircles the body. As a ready and efficient substitute for the linen roller, two pocket-handkerchiefs may be used in the application of this form of bandage.

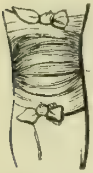
FIG. 340.



Suspensory bandages are to be procured ready for use of an instrument-maker, though occasionally they must be improvised by the surgeon; for such an emergency, a handkerchief or a piece of bandage being tied around the abdomen just above the crests of the ilia, a second handkerchief should be passed beneath the scrotum, and attached in the manner represented in figure 340.

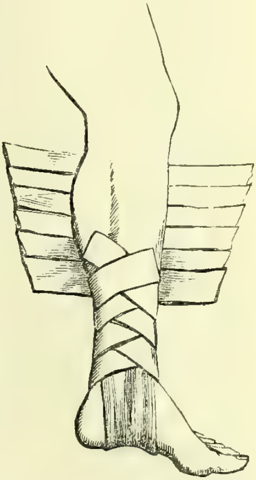
The *four-tailed bandage* is made by taking a piece of linen about six inches wide and a yard and a half long, and splitting it up the middle from either end to within three or four inches of the centre; this would form such a bandage as might be applied over the knee; but of course the size of the apparatus must be regulated by that of the part of the body to which it is to be adapted. The form of bandage under consideration is generally employed for maintaining in position topical applications, but is occasionally made use of to secure the correct apposition of fractures ; it is applied over the knee-joint, to the lower jaw, and on the vertex. To adjust this bandage to the knee-joint, the centre of it should be placed on the patella, the four tails, being passed around and under the knee and crossed behind the limb, should be brought forward again, the lower pair being tied together in front of the thigh above the patella, the upper pair over the head of the tibia on the anterior aspect of the leg. For the lower jaw the bandage should not be more than three or four inches in width, and a hole should be cut in its centre to admit the prominence of the chin ; in adjusting it, the centre of the bandage should be placed under the chin, and the tails being carried upwards, the hindermost pair should be tied over the vertex about the situation of the coronal suture, while the anterior pair of ends are taken backwards and fastened together above the occipital protuberance. When applied to the vertex, the bandage should be wider than that required for the chin ; its centre being placed on the vault of the skull, the posterior tails should be brought down and tied together beneath the chin, while the anterior pair are carried backwards and fastened beneath the occiput, or brought round again under the chin (fig. 337, K).

FIG. 341.



The *many-tailed bandage.*—The advantage of this form of application is, that it can be applied and removed without any disturbance of the parts to which it is adjusted ; and thus it is chiefly used in the treatment of compound fractures, in the dressing of stumps after amputation, or in any case where absolute quietude is desirable. The bandage is constructed in the following manner : to a wide piece of roller, rather longer than the part of the limb to which the bandage is to be applied, should be stitched in succession several shorter portions of a narrower bandage ; these should be attached by their centres in such a manner that each piece is at right angles to the long roller, and overlaps the preceding piece by one-third of its width. These shorter portions should be each about half as long again as the circumference of the limb they are to surround. This bandage, like the spiral, should be applied from below upwards ; the back piece should be drawn up behind the limb or part which is to be bandaged, and the transverse portions spread out evenly on either side, the last piece sewn on standing first in order for application. Beginning from below, the opposite ends of these transverse pieces should be crossed over each other around the limb, each succeeding pair overlapping and keeping in place the ends of bandage that immediately preceded them (fig. 342); the last pair may be tied together, or kept in position with a pin.

FIG. 342.



IMMOVABLE APPARATUS.

Under this head it is proposed to consider those methods of bandaging by which support and immobility are secured; the essential principle of the application being that it admits of adaptation while in a moist and pliant condition, and is thus enabled the more exactly to accommodate itself to the conformation of the parts to which it is applied, before assuming its permanent condition of immobility.

Gum and chalk, white of egg and flour, gypsum, starch, dextrine, leather, gutta-percha, millboard, pasteboard, Hide's felt, are any of them made use of in combination with the ordinary bandage for the above-named purpose. These forms of immovable apparatus are employed in the treatment of fractures, in chronic joint-affections, and other diseases where it is necessary to maintain permanent immobility or pressure.

Gum and chalk is prepared by rubbing together in a mortar mucilage with a sufficient amount of chalk to form a mixture about the consistence of thick cream. The limb being placed in the position in which it is desirable it should be retained, should be protected over its more prominent points with a layer of cotton-wool. Having been firmly and evenly bandaged, the gum and chalk may be smeared over the roller with a brush or the open palm of the hand; in doing this the hand or the brush should be applied to the part in the same direction as the spiral of the roller, that is, around the front of the limb, from left to right. If a great amount of rigidity is required, a second bandage may be applied, and treated in the same manner; or the apparatus may be still further strengthened by combining with the bandage gutta-percha, leather, or pasteboard splints moulded to the parts while in a pliant condition. These should be applied to the limb immediately over the cotton-wool sheathing, and they may be retained in position during the application of the first bandage by strips of adhesive plaster. The gum and starch bandage takes from four to five hours to dry, and during this time, if there is any considerable tendency to displacement in the limb, means must be used to counteract it until the application has become rigid. For this reason it is that the plaster of Paris, or gypsum bandage as it is called, is preferred by many to the gum and starch.

The gypsum bandage.—For this form of application a roller, which should be of coarse and open material, must be previously prepared by rubbing into its texture dry powder of plaster of Paris. The surgeon should have at hand a bag of the same material, and a basin of water. The limb being protected with a layer of cotton-wool, the prepared roller should be immersed in water for about a minute; it is then ready for immediate application. It should be rolled around the limb in a spiral manner, just as an ordinary bandage; after every second or third turn of the roller, the left hand should be plunged into water and smeared over the part last applied. When the whole has been thus treated, the exterior of the bandage should be rubbed over with a paste of plaster of Paris and water, until a smooth surface and sufficient rigidity have been attained. This form of application, after the lapse of ten minutes or a quarter of an hour, will have acquired its permanent condition of rigidity.

Starch, white of egg, and dextrine, are all used in their fluid forms as stiffening materials for bandages. The roller may be soaked in a solution of one or the other of these substances previous to its application; or again, the roller being cut into short pieces, each half as long again as the circumference of the limb, these portions may be applied separately to the part from below upwards; the opposite ends of each piece crossing one another, over the anterior aspect of the limb, and each succeeding piece overlapping the one that went before it by one-third of its width. Strips of paper soaked in any of the above-named solutions may be advantageously applied in the manner just described.

Gutta-percha, pasteboard, millboard, or *leather,* may be used in combination with any of the above stiffening materials to give additional firmness and permanency to the application. These, being cut into pieces of the required dimensions, must be moulded to the shape of the part while in a pliant condition.

Gutta-percha is rendered fit for application by plunging it for a minute or two into *hot* water. Millboard, pasteboard, and leather, may be prepared for use by soaking them for a sufficient time in *warm* water. Before applying splints formed of these materials to a limb, the whole part should be carefully swathed in a layer of cotton wool. In many hospitals it is the practice first to envelop the limb in a dry roller, and, having moulded pasteboard splints to fit the parts, to fix these by applying a bandage previously saturated with a thick solution of starch. The material called Hide's felt being lined with wash-leather, can be applied next to the skin.

In adjusting the immovable apparatus to a compound fracture, or to any part where it is desirable that an aperture should exist for the escape of matter or for the dressing of a wound, the application should be effected in the ordinary manner, and subsequently the bandage over the wound or sinus may be cut away to the necessary extent.

One great advantage attaching to the form of apparatus under consideration is the manner in which it may be adapted to changes in the size of the limb. When, from swelling of the parts beneath, it is necessary to loosen the bandage, the whole application should be cut from end to end with strong scissors or a knife, on the anterior aspect of the limb; this will entirely relax the parts. Subsequently the degree of support and pressure to be exercised may be regulated by passing straps and buckles around the case in which the limb now lies, and tightening or loosening these as occasion may require.

Where, from subsidence of swelling or other causes, it becomes necessary to tighten the application, a longitudinal strip may be cut out of the apparatus from end to end, and with straps and buckles the sides of the case may be brought more nearly into apposition.

There is sometimes considerable difficulty in removing the so-called immovable apparatus; this may be overcome by surrounding the parts with a wet cloth for some time before the removal is attempted. When the bandage is thoroughly soaked, it may be uncoiled from above downwards with little difficulty, or it may be cut with scissors, layer by layer.*

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* Or a piece of wide tape is laid beneath the bandage at the time of its application, the lower end being left hanging out; this is used to raise the bandage upon, while it is divided with the scissors.

SUTURES AND THEIR APPLICATION.

Sutures are used for bringing together and maintaining in contact the opposed surfaces of wounds. They differ both in the method of their application and the material of which they are composed: this difference is owing to the varying necessities of wounds, as these vary in character, or occur in one or another part of the body. There are four principal varieties in the method of applying sutures: (1) the continuous; (2) the interrupted; (3) the twisted; (4) the quilled; in these the material employed may be silken or hempen thread, horsehair, iron, or silver wire.* Under the head of each of the principal forms of suture, the material of which it may be composed will be referred to more particularly.

To save subsequent repetition, certain general principles applicable to all forms of suture will be noticed. In passing the needle, the edges of the wound may be advantageously held in contact with the forefinger and thumb of the left hand, or they may be simultaneously tightened so as to bring them parallel to each other, that their opposite and corresponding parts may exactly coincide. The needle should penetrate the surface at an angle of 50°, and should at least pass through the whole thickness of the integument at each stitch; as a general rule the thread should penetrate to a sufficient depth to avoid leaving beneath it in the wound any considerable cavity or space in which pus can accumulate. The distance from the edge of the wound at which the suture should enter and leave the part, must necessarily vary with the depth of the wound and the amount of tension to which the thread will be subject, but in no case should there be less than the eighth of an inch between the suture-hole and the margin of the wound. Sutures, as a rule, ought not to include vessels, nerves, fasciæ, muscles, or tendons. Where more than one suture is used, the interval between the points of suture in the wound should be sufficiently small to overcome any tendency there may be for the edges of the wound to evert, or the fat and subcutaneous tissue to bulge. The line of the thread ought to cross that of the wound at right angles; and in cases where the thread has to be tied, care should be taken that the knot may fall on one side of the line of contact of the edges of the wound. A single knot having been tied, some precaution should be taken to prevent it slipping while the second knot is prepared. This may be tied firmly, but need not be tightened by the exercise of any force; the fingers are sufficiently strong to effect its proper adjustment, without making unnecessary or unseemly muscular efforts.

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* The shotted suture, the clamps and other forms attaching themselves to special regions of the body, will be found described in the essay on PLASTIC SURGERY, and in the account of the various plastic operations.

The size of the needle employed for passing continuous or interrupted sutures should be adapted to that of the thread to be carried, and to the depth of the tissues to be traversed. The shape of the needle, whether straight or curved, should bear relation to the situation and nature of the wound. For incised wounds on the exterior of the body, where the edges can only be transfixed from the cutaneous surface, or where the opposite margins of the wound can both be traversed by one plunge, a curved needle is best adapted; whereas a strong straight needle is more convenient for the completely free margins of extensive wounds, such as are left by the removal of large tumours, or after amputations.

The continuous suture is for the most part used for the accurate apposition of wounds having thin and delicate edges, such as those of the eyelids or intestines. The application consists in the simple sewing together of the wound from side to side; the first stitch being tied, to prevent its pulling through. This form of suture may be fastened off by knotting together the free end of the thread with the stitch last passed; or by clamping with a small perforated shot; it can be removed by cutting with fine-pointed scissors each portion of the thread as it passes across the line of the wound, and subsequently withdrawing these portions separately. Silk, fine thread, horsehair, or silver-wire may be used for the continuous suture, and the needle should be small and curved at its point.

The interrupted suture is more general in its adaptation than any other form, being used in wounds of almost every description. Although from its very nature it does not maintain the surfaces of a wound in such close and absolute contact as can be secured by the continuous or twisted suture, yet it possesses certain advantages over these, both in the facility with which it is applied and subsequently withdrawn (piecemeal if need be), and in that while it puts the parts in such a condition that union is most likely to take place, yet, in the event of the healing process being retarded, it offers no serious obstacle to the discharge of matter. For the application of this suture the needle may be either curved or straight, its form varying with the disposition of the parts to which it is to be applied. The peculiarity from which is derived the name of this form of suture, consists in the cutting of the thread after each complete stitch, and tying the ends together, over, or rather just on one side of, the line of the wound. In wounds with edges of considerable thickness and extent, the needle is generally passed separately through the opposite margins, being first introduced from the cutaneous surface towards the deeper aspect of the parts, and subsequently from the cavity of the wound towards the surface of the body.

Silken and hempen thread, the materials formerly made use of for the interrupted suture, have now very generally given place to silver or iron wire. These latter possess most decided advantages over silk, or any thread of vegetable origin, in their cleanliness, and in the diminished tendency they show to excite irritation in the tissues through which they pass.* For the introduction of metallic wire, as a substitute for threads of organic origin, we are greatly indebted to Sir J. Simpson of Edinburgh, who, by the publication of the results of his experiments on animals, and by the success that attended his use of the same suture in man, first drew general attention to the subject in this country. In 1849, Dr. J. Marion Sims was the first to apply the same description of suture in America.† Dr. Sims' claims to priority had, however, been anticipated (at least so far as the principle involved was concerned) some two hundred years before by Fabricius ab Aquapendente, who, writing in 1647, refers to the imperfections of the materials for suture at that time in use, namely, that they excited irritation, produced discharge, and easily ulcerated out. As a substitute, he recommends iron or brass wire sharpened at one extremity and annealed elsewhere, thus forming both needle and suture of one continuous piece of metal.‡ Again, in our own country, in the year 1834, Mr. Gossett* successfully treated a case of vesico-vaginal fistula by silver-gilt wire sutures, and curiously enough, adopted the same position for the patient that is now found most convenient for the performance of the operation; a position, the advantages of which Dr. Marion Sims believed himself to have been the first to discover.

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* My personal experience, in opposition to Sir J. Simpson's observations, leads me to give a decided preference to silver over iron as a material for metallic suture, and this is, I believe, in accordance with the opinion entertained at most of our metropolitan hospitals.

† Anniversary Discourse, 1858, before the New York Academy of Medicine.

‡ See Dr. Aveling's letter to *Medical Times and Gazette*, January 22, 1859, where the whole passage from Fabricius is quoted at length.

For carrying a metallic thread, an ordinary needle of rather large size, and pretty deeply grooved behind the eye, may be employed, or one of those specially made for passing this description of suture. Of these there are three varieties, namely, that invented by Mr. Price, having two eyes, and being deeply grooved (fig. 1); Mr. Lister's, furnished with one eye, and grooved laterally (fig. 2); and that recommended by Mr. Murray, having an open end, and a groove on the side to admit of the end of the wire being doubled on itself (fig. 3). Silver wire, if kept long, soon loses its softness and pliability, and becomes unfit for sutures; it may be reannealed at any time, and best of all just before it is required for use. Metallic sutures are generally fastened off by first crossing, and then twisting, the opposite ends of the wire together, until sufficiently secure to resist the tension to which they will be exposed; a better way is by tying the ends together in a double knot. In applying these sutures to the prepuce or elsewhere, where the edges of the wound are thin and delicate in structure and the tissues around of lax disposition, some care must be taken lest the edges of the wound themselves be twisted and bruised in the process of fastening the suture. For horsehair sutures a very fine needle may be used, the hair being fastened through the eye of the needle by a single knot.

FIG. 343.

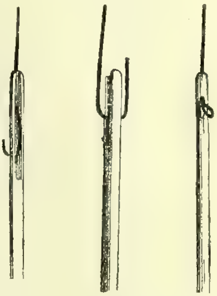

Fig. 1. Fig. 2. Fig. 3.

When the interrupted suture is formed of silk or thread, it is easily removed by dividing it with the point of the scissors just away from the knot, grasping this in the forceps, and gently drawing out the suture. Metallic threads may be removed by cutting the wire and straightening the ends before withdrawing it, or better, by cutting away a portion of the wire,—nearly all the part exposed to view,—and withdrawing the remainder with the forceps, pulling towards the line of the wound, so as to make the wire describe a slight curve in its exit, suited to the shape which it has assumed. The foregoing is one of the best methods of removing metallic sutures, a proceeding which, owing to the stiffening of the wire, is liable to be somewhat painful in its execution, unless some such plan as the above be adopted: this difficulty in their removal seems to be the great drawback to the employment of metallic sutures. It is inexpedient, particularly in hospital practice, to leave metallic sutures in a wound, in the hope that they will slough out; the wire, or at least so much of it as is beneath the skin, will in the majority of cases become encysted, and may subsequently prove a considerable source of inconvenience.* As an instance of the tolerance of metallic sutures exhibited by certain tissues, we may mention the case of a woman who still retains a silver suture in the anterior wall of the vagina, introduced by Mr. Wormald several months previously for the cure of vesico-vaginal fistula; this patient has since borne a child.

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* *Lancet*, November 29, 1834.

Before removing interrupted sutures, it is usual to support the intervals of the wound between them by strips of adhesive plaster; but for further information on this point the reader is referred to the essay on Wounds, Vol. I. p. 641.

The twisted suture will retain in immediate contact the whole surfaces of a wound of considerable depth; it is employed in the operation for hare-lip, in many wounds of the face, especially such as lay open the cavity of the mouth, and in extensive wounds of the abdominal walls.

Hare-lip pins, cutting wire-pliers, and silk, twine, or some soft thick thread, are required for its application.

The edges of the wound being held in contact, or at all events being carefully maintained in the same horizontal plane, the pin should be made to transfix the wound, entering the skin from half an inch to an inch from one of its margins, and appearing at the same distance beyond the opposite. The requisite number of pins having been passed, a piece of silk, or whatever other material is chosen for the suture, should be twisted over each pin in the form of the figure 8, so that the circles of the figure surround the extremities of the pin, and the crossing of the thread lies over the line of the wound.

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* A fine silver ligature, which had been placed on the radial artery at the wrist, was removed three months afterwards by myself, on account of the inconvenience it caused the patient.

The same thread may be made to serve for all the sutures, provided it is sufficiently long, being passed continuously from one pin to the next below it. The opposite ends of the ligature being tied together, each pin may be shortened at its pointed extremity, and adjusted so as to leave about half an inch projecting on either side. The skin may be protected from these rough-cut ends by passing beneath them a strip of soft lint; and the whole is best covered with the same material dipped in oil. In withdrawing this form of suture, the heads of the pins should be grasped in the forceps, and loosened by a slight rotatory movement; they may then be drawn out, while the finger and thumb are placed on the suture itself, to prevent any traction being exercised on the margins of the wound. When the cut surfaces, to which the twisted suture is applied, are of great thickness, it is sometimes necessary to add a few interrupted sutures at the extreme edges of the wound to prevent the eversion of the fat and subcutaneous tissue.

In applying the twisted suture to the face, or elsewhere where a sightly cicatrix is a consideration, great care is needed, in transfixing the parts, to keep the margins of the wound exactly on the same level. To avoid any doubling-in of the skin, it is well to tilt up the edges of the wound while passing the pin through them.

For this suture the softer varieties of thread possess a considerable advantage over silk or twine; the latter, from the firmness of their texture, being too apt to bruise the soft parts beneath them; on this account some adopt the plan of using narrow strips of lint to wind around the ends of the pins.

The quilled suture is adapted to wounds of greater depth than those to which the preceding variety of suture should be applied; of itself it can maintain in apposition the deeper parts of such a wound, and in conjunction with the interrupted suture it will keep in contact the whole surface. In the hands of some it is found very useful in the treatment of lacerated perinæum, or it is employed in deep wounds of the buttock and fleshy parts of the thigh. It is best applied with a strong curved needle, fixed in a handle, and having an eye near the point. This should be threaded with the loop of a double thread, formed of some stout material; and having been passed through the wound from side to side, the looped end of the ligature may be detached from the eye and held with the left hand, while the needle is withdrawn. The needle should pierce the skin not nearer than an inch from the edge of the wound, and should traverse the deeper parts, and emerge at the same distance beyond its opposite margin. This proceeding will leave a double thread through the wound with a loop on the one side and two free ends on the opposite. Through the loop (or loops if more than one suture be employed) a piece of gum catheter should be passed, and the thread drawn tightly over it, while the other ends are tied firmly over a similar piece on the opposite side of the wound. To maintain perfect apposition in the more superficial parts, it is generally necessary to add a few interrupted sutures at the extreme margin of the wound.

By cutting the looped ends of the threads this form of suture may easily be removed.

Serres-fines are occasionally employed for bringing together wounds of very thin skin or mucous membrane. They are small spring-wire forceps; their points are finely serrated, and their handles cross one another, so that when at rest they are closely in contact. The points are generally bent at right angles to the spring, so that the handles of the serres-fines may lie evenly over one another along the line of the wound in an imbricated manner. In adjusting these, one should apply them at regular intervals to the lips of the wound, taking care that the handles of each pair are turned in the same direction, so as to overlap those of the preceding pair; any dressing that the wound may need can be laid on it subsequently.

COUNTER-IRRITATION.

Counter-irritants, as their name implies, are used for the purpose of exciting local irritation; they vary in degree from simple rubefacients, which merely produce transient congestion of the cutis, to such as completely destroy the tissues exposed to their influence. They may conveniently be studied in two groups—(1) those whose effects are comparatively transient; and (2) those that excite a more permanent local irritation, or that maintain a continued drain on the system. Under the first head are included rubefacients, vesicants, acupuncture, and the like; under the second, the moxa, issues of various kinds, setons, and the actual cautery. *Rubefacients* may be generally defined as applications to the surface of the body, which irritate the cutis sufficiently to produce reddening of the parts, without leading to any of the more serious results of inflammation. For this purpose various liniments are employed, such as the linimentum ammoniæ, l. cantharidis, l. acidi acetici, l. terebinthinæ, l. olei crotonis tiglii; the potassio-tartrate of antimony in the form of ointment, and mustard-flour in the form of poultice. With the exception of the last named, all these substances may be applied to the surfaces by friction with a piece of flannel, the skin of the part having been previously cleansed with warm water; the skin may be rubbed until it has acquired a ruddy hue, and a smart tingling sensation is experienced in the parts. Croton oil and the potassio-tartrate of antimony differ from the other substances in this group, in being more decided in their effects, and in producing a characteristic pustular eruption.

Mustard-flour, the most popular and useful of rubefacients, can be used in the form of tissue or mustard leaves as they are called, or may be made into a poultice with water of a temperature from 90° to 100°; water of a higher temperature than this is liable to coagulate the albumen of the mustard-flour, while a much lower hinders the disengagement of the volatile oil upon which the irritant property of the application depends. Vinegar, which is often mixed with the poultice, has the effect of diminishing its activity. The effect of sinapisms may be in a measure regulated by mixing with the mustard, wheat-flour or linseed-meal, and by modifying the duration of the time during which they remain in contact with the skin. The London Pharmacopœia directs that equal proportions of linseed-meal and mustard-flour be used; while the time during which the application should remain on may be broadly stated to vary from ten minutes to half an hour. It may best be estimated by observing the texture of the skin of the patient, and being at the same time guided somewhat by his expressions of pain.

When sinapisms are employed to patients in a comatose condition, special care should be taken lest they remain for too long a time in contact with the skin; and this not only on account of the absence of any indications for their removal from the sensations of the patient, but also from the possibility that the part to which they are applied may be already lowered in vitality by the loss of nervous force. This form of rubefacient may be employed to any part of the surface of the body, though it is well not to expose the skin of the face to its influence. Very delicate or irritable skins are best guarded from its undue action by interposing a thin piece of cambric or tissue-paper beneath the poultice. After the removal of the application, the surface should be gently sponged with warm water, and a piece of cotton-wool may be placed over the part; or, if the pain be severe, a piece of linen or lint smeared with simple cerate.

Vesicants are substances which, in contact with the external integument of the body, excite such irritation of the cutis as to determine the effusion of serum from its surface, leading to the separation of cuticle, and the formation of a vesicle. As a general rule they are employed as derivatives or counter-irritants in chronic inflammatory affections; or after the more active symptoms of inflammation have passed by, they are used either to quench the smouldering remains of an acute attack, or to stimulate the absorbents to the more speedy removal of some inflammatory product.

To produce vesication, cantharidine in one of its various forms is generally employed; though liquor ammoniæ, chloroform, or iron heated to 212° F., are occasionally used; it is also said that mezereon-bark, soaked in vinegar, and applied to the skin, is capable of raising a blister on the surface.

Cantharidine is employed in the form of the emplastrum cantharidis, blistering fluid, and blistering tissue. The skin of the part being previously well cleansed with warm water, or sponged with vinegar, the application should be so adjusted that it may remain in close contact with the skin; for this purpose the emplastrum cantharidis is generally spread upon diachylon plaster, and the blistering tissue can be fixed with strips of the same material. In cases where, from the delicate texture of the skin, or from known idiosyncrasy, there is fear lest urinary irritation arise from absorption of the cantharidine, the surface of the blister may be dusted over with powdered camphor, or better, a piece of oiled tissue-paper may be interposed between the blister and the skin. In no case should the application be made over a raw surface, nor, if avoidable, on the site of a recent cupping. The employment of blisters is not admissible in the case of children suffering from any low or exhausting form of disease; in them sinapisms will be found to produce quite as much irritation of the cutaneous surface as it is safe to employ. The period during which the preparations of cantharidine should be allowed to remain in contact with the skin varies so greatly, and is dependent on such diverse conditions of sex, age, and idiosyncrasy, that we cannot attempt to lay down any general rules on the subject; the patient's own sensations will afford some guide to the amount of irritation that has been excited: if the application be slightly raised, it can be ascertained whether any effusion of serum has taken place. If the blister has been applied during some hours without producing the desired effect, it will be well to remove it; and should any considerable reddening of the surface exist, a warm linseed-meal poultice applied to the part will often suffice to determine a copious effusion of serum from the surface of the cutis.

Vesication may be more rapidly produced by the application of the liquor ammoniæ, or iron heated in boiling water, to the surface of the body. These agents are but rarely employed in this country, though the one or the other might be advantageously employed where rapid denudation of the cutis is required, for the application of remedies by the endermic method. One of the best plans of using the liquor ammoniæ is to steep a piece of lint the size of the part to be vesicated in the strong solution, and apply it to the skin until the ammonia has passed off by evaporation; in most cases this will almost immediately raise a blister. A very manageable and speedy counter-irritant, which at the same time appears to possess a certain local anæsthetic property, has been introduced by Mr. Little, of Singapore. It consists of a small piece of lint steeped in chloroform, and covered entirely with a watch-glass, applied to the skin and gently pressed down with the palm of the warm hand. It may remain in contact with the skin from five to ten minutes, when it will generally be found to have produced pretty decided reddening of the part, and occasionally vesication. This application has been found especially suited for facial neuralgia, or rheumatic affections of the sciatic and other nerves.

To apply the heated iron as a vesicant, an ordinary hammer with a flat head, or better Dr. Corrigan's thermal hammer, as it is called, should be heated in a spirit lamp or plunged into boiling water for about a minute, dried, and immediately applied to the part to be blistered; the contact of one or two seconds is sufficient to produce the desired effect. Such a hammer immersed in water at 120° F., and held for two or three seconds in contact with the skin, will act as a rubefacient;

while, if allowed to remain in contact from five to ten seconds, it will generally produce vesication.

Whatever means are employed to produce the effusion of serum beneath the cuticle, the subsequent treatment of the vesicle must be pursued with one of two objects in view; either to render the injury to the part as transient as possible, and to restore the integrity of the cuticle, or to establish a permanently secreting surface. To effect the former, the vesicle, being opened with a large puncture at its most dependent part, may be allowed to empty itself; subsequently it may be covered with a layer of cotton-wool, which can remain undisturbed until the new cuticle be formed beneath; or after the evacuation of the serum, the part may be dressed with simple cerate spread on linen or lint. If, however, the blister is to be kept open, the cuticle being pinched up with the forceps may be divided with the scissors around the circumference of the vesicle, and removed at once, the raw surface being dressed with the ceratum sabinæ, or whatever other application is selected as an irritant. This process of stripping off the cuticle, and at once exposing the denuded cutis to an irritant ointment and the external air, is extremely painful; the pain may, however, be avoided by leaving the cuticle in contact with the surface of the part after dividing its connections in the manner above described; the dressing may be applied over the cuticle, and the latter will separate in a few days, thus leaving a raw surface that will gradually have become inured to the stimulus of the external air.

Various irritating applications are made use of to maintain a constant secretion from blistered surfaces; the unguentum sabinæ, or the ceratum and unguentum cantharidis, are usually employed, spread on lint or linen rag. A convenient and nearly painless irritant is found in the *papier épispastique*, which is kept by most chemists: at each fresh dressing the part should be cleansed with warm water; a process needed as a general rule every day, and in summer weather twice during the twenty-four hours. There is a limit to the time during which a blistered surface should be kept discharging; when the granulations become large, spongy, or tuberculated in appearance, it is well to discontinue irritant applications, lest an uneven and unsightly cicatrix be produced.

When vesication has been employed to allow of the introduction of drugs into the system by the endermic method, the blister may be opened by a small puncture, which should not be situated on the most dependent aspect of the vesicle. The serum being pressed out, the substance to be administered may be introduced through the opening in solution, by means of a small syringe, or it may be applied in powder to the raw surface of the cutis. The foregoing method is now, however, superseded by the introduction of Dr. Wood's syringe and hollow needle, by means of which substances can readily be introduced into the subcutaneous cellular tissue.

The *hypodermic* or *subcutaneous* method of medication, introduced by Dr. Alexander Wood, is specially adapted to the administration of anodynes. We are largely indebted to Mr. Charles Hunter* for a more precise knowledge of its varied uses and general effects on the system, and for a demonstration of the more speedy and powerful action of drugs given hypodermically as compared with the effects of similar doses taken into the stomach. Morphia injected subcutaneously has a less disordering effect on the stomach than when given by the mouth; while from the manner of its administration it can be given in conditions when the irritability of that organ would otherwise preclude its use.

The solution of morphia generally used is one consisting of ten grains of the acetate of morphia to a drachm of distilled water; acetic acid being added in sufficient quantity to dissolve the salt; liquor potassæ is then added, drop by drop, until a slight film is produced, so that there may be no excess of acetic acid: from one-sixth to one-third of a grain of the salt is the usual dose, or from one to three minims of the solution.

If the general constitutional effects alone of the drug be required, it may be introduced into the subcutaneous tissue of the forearm, or at any other convenient spot; but if, as in the case of some neuralgiæ, a more local action is desirable, the injection may be made near the seat of pain. Whatever part be selected, the skin being pinched up between the forefinger and thumb, the tubular needle may be thrust in, and the solution injected.†

Permanent counter-irritation may be maintained by means of the repeated application of blisters, each succeeding one being applied so soon as the one that preceded it has ceased to discharge. This plan seems to exercise a more decidedly counter-irritant effect; it is less irksome to the patient; and in chronic inflammatory affections of the joints, and analogous cases, it is an excellent substitute for some of the more formidable counter-irritants.

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* *Med. Times and Gaz.* 1859.

† See 'Report of Committee on the Hypodermic Method of Injection,' *Med.-Chir. Trans.* vol. l., which confirms the conclusions previously announced by Mr. C. Hunter.

As a vesicant and general counter-irritant nitrate of silver has been most strongly recommended by Mr. Higginbottom; and to his interesting pamphlet on the subject the reader is referred for an elaborate account of its action, and its various applications to surgery.

Acupuncture.—This operation consists in the introduction of sharp-pointed needles into the subcutaneous tissue of the body; these are allowed to remain for a longer or shorter time, and are then withdrawn. Its chief use is in neuralgic affections, particularly those of the sciatic nerve, where it is employed for its counter-irritant effect. Its efficacy in certain obscure cases of painful muscular rigidity is highly spoken of by Dr. F. Ogier Ward, who recommends the insertion of the needles among the muscular fibres, retaining them there for some time. As a purely mechanical agent acupuncture is made use of to drain away œdematous effusions in the subcutaneous cellular tissue. The needles for this purpose are made short and strong, and fixed in cylindrical handles. They may be introduced by drilling through the skin with a rapid rotatory movement, effected between the forefinger and thumb of the right hand, the skin of the part being at the same time stretched between the fingers and thumb of the left hand; when the needle is withdrawn, the rotatory movement should be again adopted to facilitate its exit. Acupuncture is sometimes effected by percussion; the point of the needle being placed upon the skin, its handle is smartly struck so as to drive it suddenly through the integuments: lastly, the needle may be introduced with a sudden stabbing movement. In withdrawing the needle in either of the last-named methods, the skin on either side the puncture should be held down with the finger and thumb. Of the three plans the first seems to exercise the most decidedly counter-irritant effect.

Electro-puncture is nothing more than the application of a galvanic current to the tissues included between two acupuncture needles; these are introduced in the ordinary manner, and the negative and positive pole of the battery being connected respectively to one and the other of the needles, the current may be established between them. This form of counter-irritation is employed in the same description of cases as the acupuncture: its application, however, is far more painful; its chief use lies in the means which it affords of directly acting upon paralysed muscles.

Under the more permanent forms of counter-irritation are included (1) issues of various kinds; (2) setons; (3) the application of the actual cautery.

1. Issues are sores artificially produced, giving exit to a continued discharge; they are employed for local causes as counter-irritants; or for constitutional maladies, to establish a perpetual drain on the system. When instituted for the latter purpose, some part of the body should be chosen where the subcutaneous cellular tissue is abundant, and also convenient by its position for subsequent dressing of the sore. Prominent points of bone and the neighbourhood of large veins, or cutaneous nerves, should be carefully avoided; the upper and outer part of the arm just below the insertion of the deltoid is the common spot selected for the formation of an issue; or on the lower extremity they may be conveniently placed on the inner side of the thigh, just above the knee-joint, and clear of the saphena vein. Though there is but little room for choice of situation when issues are applied for local purposes, yet the general rules that are mentioned above should, if possible, be observed.

Issues may be established by means of (*a*) various caustics, (*b*) the moxa, or (*c*) the use of the knife.

(*a*) For the formation of caustic issues, either caustic potash or Vienna paste is generally employed. To apply the caustic potash, a piece of plaster having a small hole cut in its centre, half the size of the intended issue, should be applied to the part to protect the surrounding skin; a bit of potash, the size of a small pea, may be placed over the hole in the plaster, and covered with a layer of soft lint; the whole may be retained in position by strapping, and should remain undisturbed until the caustic has exercised its full effect, that is, until it has destroyed the entire thickness of the skin; and this will generally take place in about four hours. On removing the application an ash-coloured central slough should be seen, surrounded by a bright halo of congestion: simple dressing or a poultice may be applied until the dead parts separate.* The size of the slough will generally be fully twice as large as that of the hole in the plaster; its depth will depend upon the quantity of the caustic employed. A more convenient method of applying the caustic potash is by mixing it with soap, in the proportion of three parts of the former to two of the latter; this diminishes the tendency of the potash to diffuse itself over the surrounding skin, and at the same time does not materially lessen its activity. *Vienna paste* is a mixture of five parts of caustic potash with six parts of quick-lime. This compound possesses decided advantages over the caustic potash, in the greater rapidity of its action, and in being more easily confined to the spot to which it is applied. The powder should be made into the consistence of a paste by mixing it with alcohol; and being applied to the skin in the same manner and with the same precautions as the caustic potash, may be allowed to remain in contact for fifteen or twenty minutes, or longer if the integuments of the part are very dense. After the removal of the paste the parts may be gently washed with warm water, and simple dressing or a poultice applied until the slough separates.

(*b*) The actual cautery in the form of the moxa, though generally employed for its immediate irritant effects, is not unfrequently made use of for the formation of issues; for this purpose it is preferred by some surgeons as exercising a more decidedly counter-irritant effect, especially in certain affections of the joints, and in carious diseases of the bones of the spinal column. The moxa is a tightly packed solid cylinder of cotton wool, fitting into a metallic tube, open at both ends, and attached to a handle. The moxa being introduced into this tube, one end should be thoroughly ignited; and the opposite end being held in contact with the skin of the part, a continuous current of air should be maintained against its surface by means of a blowpipe, until the whole of the cotton-wool be consumed. Meantime the surrounding parts may be protected from injury by covering them with a thick layer of wet lint. The size of the eschar will be somewhat greater than that of the end of the metallic tube employed. Moxas may be prepared by soaking the cotton wool in a strong solution of nitrate of potash, and subsequently drying them: in the application of these the use of the blowpipe may be dispensed with. The pain of the moxa is excessive during its application, but is not of long duration; the resulting slough is dry, dark-coloured, and cracked on its surface, and the surrounding integuments are brightly congested; the slough may be treated in the same manner as in other caustic issues. After the separation of the dead parts, the wound is generally allowed to granulate and heal up, but it may subsequently be treated as an ordinary issue.

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* Before applying the poultice, all remains of the caustic should be carefully removed, and this is best effected by sponging the part with a solution of acetic acid.

(*c*) Issues are made with a knife by pinching up a fold of skin between the forefinger and thumb, rapidly transfixing it, and cutting it through, the cutting edge of the knife being turned upwards; or the integuments being put on the stretch, a crucial incision may be made extending into the subcutaneous tissue.

Having described the principal methods of forming issues, it now remains to allude briefly to the various plans adopted for keeping them open. So soon as the eschar separates in the case of the caustic issues, and at the time of their formation when the knife is used, one or more glass beads or issue-peas may be applied to the surface of the sore, and there retained in firm contact with the parts by means of strapping for four or five days. When suppuration is fully established, the wound should be cleansed daily, the peas being removed and replaced at each dressing; should the granulations become too exuberant, they may be touched occasionally with nitrate of silver. To prevent the wound healing, it is occasionally necessary to reapply the caustic potash or Vienna paste; but a more convenient and less painful method of effecting the same purpose is to dress the surface from time to time with the *papier épispastique*, or the issue-peas may be occasionally smeared with some irritating ointment.

Of the various methods employed for establishing issues, that by means of the moxa is the most decided in its counter-irritant properties; its effects are produced more quickly, and the issue thus formed can be kept discharging for a longer period than any other; at the same time this plan is exceedingly painful in its application. Issues formed by caustic potash or Vienna paste rank next for efficacy and permanency; while those formed by means of the knife, are both difficult to keep open and more scanty in their secretion than others, though they have the advantage of being painless in their application, since local anæsthesia can be employed.

Setons.—A seton is an artificially-produced sinus, through the track of which some material is passed to excite suppuration, and to maintain the patency of its orifices. They are established in the subcutaneous tissue of the body, (*a*) as counter-irritants, or (*b*) to act as continued sources of drain on the system. As local irritants, they are passed through various cavities to excite inflammation and procure adhesion of the opposite surfaces; or again, they are used as means of gradually evacuating the contents of cysts, chronic abscesses, and other abnormal cavities. For the purposes of counter-irritation, setons are generally inserted in the neighbourhood of the part affected; as for instance, in front or behind the ear in certain chronic affections of the eye, or over the pubes in certain diseases of the bladder. But when employed to act as drains on the system at large, the nape of the neck is the part generally selected for their insertion. To establish a seton in the subcutaneous tissue (the part having been rendered insensible with ether spray), a fold of skin should be grasped and raised from the deeper structures; this should be transfixed at its base by the instrument carrying the seton rather obliquely, so that one of the openings in the skin shall be more dependent in position than the other. The size of the fold of skin to be transfixed will depend upon the length of the seton; but in all cases the needle must pass deeply through the subcutaneous tissue, and not immediately beneath the skin, or the latter will slough over the whole track of the wound. On the nape of the neck a longitudinal fold of skin over the spines of the cervical vertebræ is generally raised and transfixed nearly at right angles to the axis of the spine. The instruments used vary with the material of which the seton is to be composed; thus, ordinary needles of various sizes are employed when one or more silken or wire threads are to be introduced, whereas, if a gum elastic band is used to keep the wound open, a properly adapted seton-needle should be employed; though in the absence of this, the parts may be transfixed with a double-edged bistoury, which will also serve as a guide for the introduction of the seton.

Whatever material is employed to keep the wound open and excite discharge, it should first be smeared with oil; and having been introduced, may be allowed to remain undisturbed for four or five days, or until suppuration is fairly established; subsequently the dressing may be changed daily, and the seton be pulled on each occasion a little farther through the wound, care being taken to oil that part of it which is to occupy the wound, before moving it. If the seton be composed of silken or other threads, when it is nearly all pulled through the wound, a fresh piece of the same material may be attached to its end, and thus drawn into the sinus. Gutta-percha or gum elastic bands need only be shifted each day one way or the other, the projecting ends being carefully wiped, so that the discharge does not accumulate and harden upon them. In the subsequent progress of the case it may be occasionally necessary to smear the ends of the seton with some irritating ointment to produce a more copious discharge from the wound.

For exciting local inflammation and adhesion the seton is employed in the treatment of hydrocele, enlarged bursæ, ranula, and elsewhere. For such a purpose, a single thread, or a silver wire, is passed through the cavity with an ordinary needle; or if the cyst be large, a needle fixed in a handle, and having an eye at its point, may be used.

Setons are nowadays but rarely employed for emptying large cysts or chronic abscesses, their use for this purpose having been superseded by the drainage-tube of M. Chassaignac. For purposes of drainage from suppurating cavities or cysts, a far more effectual and cleanly appliance has been devised by Mr. Robert Ellis in his spiral wire drainage tubes.

The *actual cautery* is some metallic substance raised to an elevated temperature, and applied to the tissues of the body; steel, iron, and platinum are the only metals now employed for this purpose. This form of cautery is made use of for arresting hæmorrhage, for destroying diseased surfaces and morbid growths, and for exciting counter-irritation of almost every degree, from simple rubefaction up to complete destruction of the skin and subcutaneous tissue.

Cauteries are made of steel, fixed in wooden handles; their heads or extremities are of various shapes, being bulbous, conical, hatchet-shaped, or hammer-headed, varying with the special purpose or part of the body to which they are applied. They may be heated in an ordinary fire, or by means of a spirit-lamp. Three degrees of temperature are generally recognised;

namely, white heat, red heat, and an inferior degree when the metal is black, or as hot as it can be without losing its natural colour. As a general rule, the hotter the metal is at the time of application, the less pain will it produce. The well known gas cautery apparatus devised by the late Mr. Bruce, is a most convenient and valuable form of cautery.

In making use of the actual cautery to a raw surface, whether for the suppression of hæmorrhage or for other purposes, the surface should first be carefully dried; the iron, flat-headed or conical in shape, may then be applied to the part with a light hand, being kept in motion, or at all events not allowed to remain in contact with any one part of the wound for more than a second or two, otherwise the disorganised tissues will stick to the metal, causing great pain, and often considerable hæmorrhage when the instrument is removed. When the hot iron is applied to the sound skin for its counter-irritant effects, a hatchet-shaped cautery is generally employed; the thin edge of this may be drawn rapidly and lightly over the surface in parallel lines, an inch or more apart. There are certain parts of the body to which this remedial measure should not be applied; these may be stated to be the immediate neighbourhood of subcutaneous bones, such as the vault of the skull and the sternum; salient points of bone, as the acromion, olecranon, patella; the course of the larynx or trachea; superficial tendons, and the neighbourhood of such synovial membranes as lie very near the surface. The effect of the heated iron may be varied in degree by holding it at a greater or less distance from the skin. Its indirect application is thus employed by many continental surgeons as a stimulant to ulcers or unhealthy wounds; the cautery being held first at some distance from the part, and being gradually approximated until the surface of the sore is covered with a thin dry scab.

For the destruction of morbid growths or cancerous ulcers, the actual cautery may be retained in contact with the diseased tissues, freshly-heated cauteries may be frequently renewed until complete charring of the parts has been effected, or the gas cautery apparatus may be employed. It may not be out of place to remark that great caution should be used in applying the cautery to a part where local anæsthesia has been induced by Dr. Richardson's spray-producer.

BLOODLETTING.

For the convenience of description, this remedial measure may be considered first in its local, and secondly in its general application. In local bloodletting the blood is drawn from the capillaries; this may be effected by leeching, scarification, or cupping. General bloodletting includes venesection and arteriotomy.

Leeching.—Leeches should be removed from water an hour or two before their application, and, having been carefully dried in a clean cloth, they may be applied to the skin of the part, after it has been carefully cleansed, freed from hair, if that exist in any quantity, and, if need be, smeared with a little milk to induce the leeches to bite. If the blood is to be abstracted from the external surface of the body, the leeches may be conveniently covered with an inverted tumbler or wine-glass until they have attached themselves; or they may be placed in the hollow of a large and loosely made pad of cotton wool covered with lint; or a clean towel may be folded so as to contain them, and being inverted over the part, may be maintained in position by gentle pressure. Again, two or three may be placed together in an open pill-box, which must be inverted and maintained in contact with the part. When it is desirable more exactly to localise the point of application, as in leeching the gums, eyelid, or lacrymal sac, the leech can be retained in position, until it has attached itself, by means of a leech-glass, or a card rolled up in a cylindrical shape. When there are but few leeches to be applied to the external surface of the body, each may be held singly between the forefinger and thumb, while its mouth is directed to the part to which it is intended it should attach itself. There are certain parts of the body where particular precautions should be adopted in abstracting blood by this means. To the eyelid, nasal mucous membrane, lacrymal sac, and cavity of the mouth, a leech-glass or rolled card ought always to be used. In leeching the eyelid, the patient should be placed in the recumbent position, and should thus remain for some time ; this will generally obviate the unsightly ecchymosis which is apt to occur in the loose cellular tissue of the part.* Leeches may be applied to the os uteri by first introducing a speculum, thus protecting the vagina and leaving the os uteri free and projecting into the cavity of the instrument; they may then be pushed down the speculum, and maintained in contact with the os by means of a pledget of cotton wool until they have attached themselves.

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* Leeches should not be applied to the upper eyelid.

A healthy leech will draw about ʒij. of blood, and this quantity may be increased by subsequent fomentation of the bite to about ℥ss. It is said that the capacity for abstracting blood may be largely increased in leeches by making minute punctures on their dorsal surface, just above the caudal extremity; of course this proceeding cannot be adopted until the leech is firmly attached and well distended with blood; it is a measure, one would think, of very equivocal advantage. When leeches, though fully distended, still remain attached to the surface, the popular applications of salt or snuff to their bodies will generally induce them to relax their hold.

To obtain a further flow of blood from the bites after the separation of the leeches, warm linseed poultices or fomentation with warm flannels are generally employed, or the part, if on one of the extremities of the body, may be immersed in warm water. When it is desirable to arrest the hæmorrhage at once, the bites may be freely exposed to the air, or the part being covered with lint or a dry cloth, pressure over it may be made with the hand, or maintained by a bandage; should this be insufficient, a little shredded lint being placed over each bite, firm pressure may be made with the finger-ends; or again, the bleeding points may be touched with nitrate of silver or perchloride of iron. In cases where the hæmorrhage is alarming, or the foregoing means have failed to arrest it, the soft parts beneath the bite may be transfixed by a fine needle, and a silk ligature may be wound around them beneath the needle-ends. In selecting a spot for the application of leeches, it may not be amiss to bear in mind the fact of the characteristic triradiate cicatrix left by the bite, and that this is indelible.

Scarification is employed in various parts of the body, as a means of directly relieving the local congestions of free surfaces. The operation consists in making small incisions on the surface of the part with the point of a lancet or scalpel; these incisions varying in depth and extent with the texture of the part affected and the severity of the local mischief. They are employed in chemosis of the conjunctiva, phlegmonous inflammation of the integuments, acute engorgements of the tongue and tonsils, and in other parts.

Cupping in its most ordinary form consists in the local abstraction of blood from minute incisions by means of atmospheric pressure; cupping-glasses, a scarificator, and a spirit lamp, are required for the performance of this operation. Cupping-glasses are of various forms and sizes, but, for the most part, narrow at their necks and somewhat dilated at the opposite extremity. They are employed for creating a partial vacuum over that part of the surface from which the blood is abstracted; the air within them is rarefied by introducing for a second or two the flame of a spirit-lamp; on the withdrawal of this, the open mouth of the glass is immediately applied to the part to be cupped. This has the effect of producing great local congestion and swelling up of the parts included within the rim of the glass. The glass may be conveniently removed by tilting it to one side, and at the same time insinuating the point of the forefinger under its edge on the opposite side. The *scarificator* is used for simultaneously and quickly effecting the necessary incisions for the abstraction of blood; it is formed of a number of blades fixed on an axis, which latter by a rapid semirotatory movement projects the blades through appropriate openings in the instrument, and divides the integument to the required depth. Before its application the blades of the scarificator should be set so as to cut through the cutis vera, but not to encroach upon the subcutaneous tissue; this being effected, the spring may be drawn back, and set, and the instrument being held pretty firmly in contact with the skin, the spring may be released.

Before the application of cupping-glasses the skin of the part should be sponged with warm water, and any hair there may be on the surface should be removed; a basin of warm water and a lighted candle should be at hand. The glasses being first placed in the warm water, should be applied, in the manner above mentioned, one by one to the part from which the blood is to be drawn; care being taken that sufficient intervals are left between the glasses: they may be allowed to remain in contact with the skin for about a minute; as each is withdrawn, the scarificator should be applied to the swollen integument beneath, and the glass should be as quickly as possible readjusted to the part. The blood will continue to flow from the incisions until the exhaustive power of the glass has ceased by the vacuum within being destroyed; when this occurs, the glass may be removed, and a fresh one may be applied to the same spot, the surface being first sponged to remove any coagula that may have formed. As each glass is removed, the blood from it may be emptied into a graduated vessel. When the required amount has been abstracted, the wounds may be sponged, dried, and each group covered with a piece of diachylon plaster.

It is often extremely difficult to procure the required amount of blood by means of cupping; and this, though it may occur from many causes, is chiefly owing to one of two reasons, namely, that either the depth of the incisions has not been rightly adapted to the thickness of the skin of the part, or that the vacuum within the glass is insufficient or too complete. To avoid both these evils requires some knowledge of the different thickness of the integument on various parts of the body, and a certain manual skill which can only be acquired by practice. When the skin has been too freely divided by the scarificator, the subcutaneous tissue is apt to bulge through the incisions in the skin and hinder the flow of blood, while the disadvantages of an insufficient division are obvious. Should the atmospheric pressure be so great as to constrict the cutaneous capillaries around the rim of the glass, this pressure may be relieved by rotating the glass a little, or by swaying it to and fro, so as to allow a little external air to get beneath its margin.

There remains to speak of another form of cupping, usually termed ‘dry cupping.’ The object of this is to abstract blood temporarily from one part of the body by detaining it for a time in other parts. To effect this, several cupping-glasses are applied and renewed at intervals, their position being slightly varied each time, so that the skin may not suffer from the pressure.

As a general rule cupping-glasses should not be applied in the immediate neighbourhood of inflamed tissues, nor over the mammary region. Their adjustment also is well-nigh impossible in certain situations, such as the perinæum, or the anterior regions of the thorax in emaciated patients.

M. Junot has devised an instrument by which he considers that he produces a transient condition of general depletion. The apparatus consists of a metallic cylinder closed at one extremity, and sufficiently large to contain either the upper or lower limb; attached to the cylinder is a small stop-cock, to which is fitted an exhausting syringe. One of the limbs is immersed in the metallic case, and a very wide india-rubber band being drawn over the open end and around the limb, so as to form an air-tight cavity, the syringe is applied until the condition of the pulse indicates that a sufficient amount of air has been removed. This proceeding is said to possess many of the advantages of general depletion without exercising any permanently debilitating effect on the constitution.*

General Bloodletting.

Venesection.—This operation may be performed upon the veins of the forearm or hand, the external jugular, the veins beneath the tongue, those of the scrotum, and the internal saphena, near the inner ankle. Whatever vein is opened, it is necessary, when practicable, to produce congestion of it, by compressing the vessel between the point to be opened and the heart. A lancet, bleeding-tape or a narrow bandage, lint, a bowl to receive the blood, and a basin of water and a sponge, are required. The operation, as ordinarily performed in this country, consists in opening one of the veins at the bend of the elbow. Of these the most prominent are the median cephalic and the median basilic, the former being situated to the outer side of the tendon of the biceps, the latter to its inner side, and immediately over the course of the brachial artery, indeed only separated from the artery by the fascial attachment of the biceps muscle. For anatomical reasons, therefore, the median cephalic should be preferred for venesection; but in practice the more prominent and larger vein of the two is selected.

The patient being placed in the sitting posture, the bleeding tape or bandage may be tied around the limb about the middle of the upper arm, sufficiently tight to arrest the venous circulation without affecting the pulse at the wrist. The forearm having been allowed to hang down until the veins are tense and turgid, the operator may select one for his purpose, and taking the blade of the lancet between the forefinger and thumb of his right hand, should fix the vein by pressing his left thumb upon it, just below the part he is about to open. Steadying his hand by resting the ends of the three inner fingers on the forearm, the point of the lancet may be introduced obliquely until the interior of the vein is reached and the blood rises up out of the wound; without penetrating any deeper, the lancet should now be thrust onwards, thus laying open the vein longitudinally, and cutting its way out in advance of the point of puncture. The vein being well opened, the thumb may be removed, and the blood allowed to flow; if the stream be scanty and sluggish, the ordinary expedient may be adopted, of directing the patient to clench his fist firmly from time to time, or the surgeon may chafe the veins on the palmar surface of the forearm, rubbing from below upward. When the required amount of blood has been abstracted, the thumb of the left hand may be placed over the wound, and the ligature around the arm relaxed; a small pad of lint being placed over the orifice in the vein, the parts around should be cleansed from blood, and the tape applied in a figure-of-eight fashion, so that the crossing of the tape lies over the pad on the vein and keeps it in place, exercising pretty firm pressure (fig. 337 F, p. 508). From a want of coincidence between the wound in the integuments and that in the coats of the vein, the blood may cease to flow altogether, or may continue to escape in a diminished stream; this is frequently caused by the wound having been made while the arm was in the supine position and by the subsequent pronation of the limb; it can generally be remedied by sliding the skin over the vein until the two wounds are made to coincide. In extreme cases of this kind, where the blood escapes into the surrounding cellular tissue, the swelling occurs to which the term thrombus is generally applied. This, if of considerable size, may be laid open with the lancet, though more generally it needs no surgical interference, but may be allowed to become absorbed. After the operation, the arm should be carried for a day or two in a sling.

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* In a case in which I had an opportunity of observing its effects, these were less marked in the constitution at large than in the limb itself; the latter seemed intensely congested, and on the removal of the instrument, was covered with minute cutaneous ecchymoses.

In children, and occasionally in others, where the subcutaneous veins at the bend of the elbow are ill-defined or of small size, venesection is practised on the external jugular. For this a pretty bulky pad of lint is required; it should be applied over the vein in the hollow just above the clavicle and external to the sterno-mastoid muscle, and should be secured by a bandage passed over it and fastened in the opposite axilla, so as to exercise firm pressure on the vein. The part of the vessel generally chosen for the operation is where it overlies and crosses the sterno-mastoid; the vein being fixed with the thumb of the left hand, the incision may be made in the same manner as in bleeding at the bend of the elbow, the line of the wound being parallel to the fibres of the sterno-mastoid muscle, so as to secure a transverse division of the platysma myoides. The blood can be directed into a bowl by means of a piece of cardboard folded in the form of a gutter, or it may be collected in a teacup held close below the wound. To arrest the bleeding, a pad must be applied over the wound, and retained by strips of plaster; the compress over the clavicle may then be removed. The possibility and the effect of the entrance of air into the vein during the foregoing operation, is too well known to require more than a passing caution, to see that the pad applied to the vein is thoroughly effectual in arresting the circulation, and to be careful not to remove this pad until after the orifice in the vein has been closed.

The saphena vein is but rarely opened for the purposes of venesection, in this country at least, though there are many Continental surgeons who consider it a more favourable vessel for the operation than the veins at the bend of the elbow. The venous current is in this case arrested by a bandage around the limb, just above the ankle; the vein is opened above the inner malleolus, and the bleeding is encouraged by immersing the foot in warm water.

The cutaneous veins of the scrotum may be advantageously opened in many cases of acute orchitis, the bleeding being encouraged by warm fomentations, and arrested when necessary by exposing the part to the external air or by the application of cold water. For the various mishaps and ill consequences of venesection and their appropriate treatment, the reader is referred to the essays on INJURIES AND DISEASES OF THE VEINS AND ARTERIES.

Arteriotomy.—The only vessel on which this operation is practised is the temporal artery itself, or one of its principal branches; the main trunk of the vessel may be found crossing the zygoma at right angles about half an inch in front of the pinna of the ear, and just above this spot the artery divides into its anterior and posterior branch. A small bistoury or a lancet, a narrow bandage, a small firm compress, sponge and water, and a bleeding-bowl, are required for this operation. The position of the anterior division of the vessel being ascertained, or that of the main trunk itself if the former be of insufficient size, its exact situation should be marked, and the vessel may be at the same time fixed by placing the forefinger or thumb upon it, just below the point where it is to be opened. The blood should be drawn from a transverse wound in the vessel, made by cutting down upon it with a bistoury; or with a lancet, by first puncturing its coats and then laying open its canal more freely. To arrest the hæmorrhage the artery may be completely divided, the part sponged, the compress applied to the wound and secured by the knotted form of bandage (fig. 339, p. 510). This should be most carefully adjusted, so that it may remain undisturbed for four or five days, when it may be removed, and the wound covered with a strip or two of plaster.

VACCINATION.

In addition to the common lancets and ivory points, there are special instruments constructed for introducing vaccine lymph. Mr. Seeley of Aylesbury has invented a small arrowhead-shaped lancet, with a groove on one of its flat sides, for carrying the lymph. A small needle, grooved up to its point, is also made use of by others. A needle with an arrowhead-shaped point has been invented by Mr. Sprattey; this has a groove on one surface, and a small rectangular shoulder about a twelfth of an inch from the point. This instrument is fixed in a hollow ivory handle, within which capillary tubes containing lymph can be carried. Dr. Husband uses an instrument, invented by Dr. Weir, having a flat ivory handle fitted with a lancet at one end, and at the other four minute needle-points; by drawing these sharply over the surface the cutis is slightly abraded; two such scratches are made, and over these the lymph is gently rubbed. These scratches should be quite an inch apart, since lymph applied in this manner generally produces a group of confluent pustules. Vaccine lymph should be taken from the vesicle not later than the eighth day after inoculation. When fresh virus is to be applied directly from a mature vesicle, the patient's left arm should be grasped in the operator's left hand, just above the insertion of the deltoid muscle, and the skin on the outer aspect of the part put on the stretch. The lancet, being previously armed with the vaccine lymph, is held with the flat of its blade turned towards the surface, and is made to perforate the cuticle very obliquely, so that its point may separate the cuticle from the cutis to a small extent; this may be effected without causing any hæmorrhage, or at most, not more than a drop of blood need escape. As it is withdrawn, the lancet may be pressed against the raw surface of the cutis, or the thumb of the left hand may be used to press the edges of the puncture together, so as to wipe the virus off the point; two or three such punctures should be made, each about an inch distant from the other, and any blood or serum exuding from them should be allowed to dry on the part.

Ivory points or slips of quill may be used to dip in the virus, and insert into punctures, instead of employing the lancet for this purpose. If dry lymph upon points be used, it must first be softened over the steam of hot water, or it may be moistened with warm water before its introduction; lymph between glass slides should be moistened and scraped off the glass with the lancet point, and thus applied. A very efficient but more painful method of vaccination is the plan of scratching off the cuticle with the lancet-point, and applying the virus to the denuded cutis.

Dr. William Husband, of Edinburgh,* has introduced and established a method by which vaccine lymph may be preserved for considerable periods of time, uninfluenced by changes of climate. This he effects by hermetically sealing it within capillary glass tubes; he recommends for the purpose such as are from two to four inches in length, and about $\frac{1}{28}$th of an inch in diameter, their walls being $\frac{1}{200}$th of an inch in thickness. The following are the directions given by Dr. Husband for charging these tubes.

The vesicles having been opened with the lancet in the usual way, the tube, held horizontally, is charged by applying one end of it (the straight end if they be not both straight, not that which tapers to a point) to the exuding lymph, which enters immediately. As much lymph is allowed to enter as will fill from about one-seventh to one half-the length of the tube. As a general rule, each tube should not be charged with more than will suffice for one vaccination. It may be sealed in one or other of the following ways. In the first, the lymph is made to gravitate towards the middle, by holding the tube vertically, and if necessary giving it a few slight shocks by striking the wrist on the arm or table. The end by which the lymph entered may then be sealed, by applying it to the surface of the flame of a candle. The other end should first be plunged about half an inch into the flame, and as quickly withdrawn till it touches the surface, where it should be held till it melts over and is sealed. This precaution, of plunging the tube into the flame before sealing it, is useful, in order to expel a portion of the air. Or the tube may be sealed thus: the lymph having been introduced at one end of the tube, is made to pass towards the opposite by exhausting the air at that end over the flame of a spirit-lamp; this end of the tube is then sealed. On cooling, the lymph will pass towards the middle of the tube; the orifice by which the lymph entered is then sealed, as in the first method. Not more than a minute or two should elapse between charging the tube with lymph and sealing it up, or the lymph will concrete at the orifice, and cannot then be forced into the centre of the tube.

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* *Exposition of a Method of Preserving Vaccine Lymph fluid and active; with Hints for the more efficient Performance of Public Vaccination.* London, Churchill, 1859.

In order to obtain the lymph from a tube for the purpose of vaccination, the sealed ends are to be broken off, and the fluid contents blown out gently on the point of the lancet or vaccinating instrument.

The result of primary successful vaccination may be stated to be as follows:* the puncture may be felt slightly elevated on the second day; on the third it is surrounded by a slight halo of redness; by the fifth a distinct vesicle will be formed, having a slightly elevated margin and a depressed centre; on the eighth day the vesicle should have reached its perfect condition, when it is pearl-coloured, and distended with clear lymph, its margin being turgid, firm, and shining. From this period the redness around increases in extent and intensity until the tenth day, when there is often well-marked swelling, and induration of the subjacent cellular tissue. On the eleventh day the areola begins to subside, leaving as it fades two or three concentric rings of redness; the vesicle begins to dry up, assuming a brownish colour; the remaining lymph becomes opaque, and gradually concretes, forming by the fourteenth or fifteenth day a dry reddish-brown scab; this contracts, dries, blackens, and finally falls off about the twenty-first day. The resulting cicatrix is permanent, slightly depressed, dotted or minutely pitted.

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* This description is taken from the account given in the instructions to public vaccinators by order of the Privy Council.

When persons who have once been successfully vaccinated are some years afterwards re-vaccinated with effective lymph, vesicles occasionally result, which in their appearance and in the course they run cannot be distinguished from those produced by primary vaccination. Far more generally these results are variously modified; either no true vesicle forms, or it attains its maturity and runs its course with greater rapidity than the regular vesicle. The areolæ also tend to diffuse themselves more widely and less regularly than in primary vaccination, and the local changes are accompanied by much itching, often by some irritation of the axillary glands, and in some cases by considerable febrile disturbance supervening on the fourth or fifth day.

CAUSTICS.

The various substances used for destroying morbid growths or the tissues of the body by chemical agency are generally termed potential cauteries. They will briefly be noticed in order, according to the degree in which they exercise their disorganising effects. And, firstly, those substances which either from their want of caustic power or from the tardiness of their action are generally applied only to raw surfaces, though occasionally to mucous membranes. These are such as tannic acid, sulphate of copper, nitrate of silver, sulphate of zinc, acid nitrate of mercury, arsenical paste, the chlorides of antimony and of zinc.

Tannic acid, as a caustic agent, is but rarely used in surgery; applied in the form of powder to raw surfaces, it produces a thin layer of disorganised tissue.

Sulphate of copper exercises sufficient caustic activity to be employed for the destruction of warts and condylomata, of fungous and unhealthy granulations, or the secreting surfaces of cysts. To produce any considerable effect, the solid salt requires to be rubbed pretty firmly over the part to be cauterised, the surface being previously moistened if dry.

Nitrate of silver, as a caustic, is applied in a solid form or in a saturated solution; it is chiefly of use in checking exuberant granulations, in destroying the surfaces of unhealthy ulcers or secreting cysts, in stimulating flagging sores, in producing a superficial slough on the surface of poisoned wounds, thereby diminishing their absorbent power, or for destroying warts and small condylomatous growths. In the solid form this salt is applied either by lightly brushing it over the part, producing a thin scale of dead tissue, of a bluish-white colour, turning to black; or by rubbing it firmly again and again over the surface, so as thoroughly to destroy the part to a more considerable depth. Dry surfaces should be slightly moistened, and very moist or suppurating surfaces require to be partially dried before this caustic is used. In solution nitrate of silver is applied with a camel's-hair brush or a small piece of sponge, the caustic effect being far less marked than when used in the solid form. Though possessing but limited power compared with many other substances, yet lunar caustic has the advantages of acting with great rapidity, of causing but little pain, and of producing but slight irritation or disturbance in the surrounding tissues.

Sulphate of zinc.—The introduction of this substance as a caustic is due to Sir J. Simpson of Edinburgh, who recommends its use either in the form of finely levigated powder, as a paste composed of one drachm of glycerine rubbed up with an ounce of the powder, or as an ointment made in the proportion of two drachms of lard to an ounce of the dried sulphate.

It is applicable to ulcerations of the os uteri, rodent and lupous sores, or indeed to almost any form of obstinate or inveterate ulceration. For destroying warts and condylomata, and the vascular growths about the female urethra, it is said to be most efficacious. Sir J. Simpson states that used in the form of powder, paste, or ointment to an open or ulcerated surface, it quickly produces a slough corresponding in depth to the thickness of the superimposed layer of caustic. The slough is of a white colour, and usually separates about the fifth day, leaving behind it (if the whole morbid tissue be removed) a red granulating, healthy, and rapidly cicatrising wound. The disorganised tissues show no tendency to decompose, but are firm and inodorous. This caustic will only act on ulcerated or abraded surfaces; where the epithelium therefore is entire, the part must be prepared for its application by the previous use of the nitric acid or some other of the stronger caustics. The pain produced by the sulphate of zinc is said to be less enduring than that caused by caustics generally, the local inflammation is very slight, and the eschar has been observed to separate in most cases about the fifth or sixth day. Among other advantages claimed for this substance by its distinguished inventor, are the facility with which it is applied, the rapidity of its action, and the certainty with which its effects can be localised, since it shows no tendency to deliquesce; nor does its disorganising power exert any influence over the surrounding surface, provided the epithelial covering is entire.

Acid nitrate of mercury is a fluid form of caustic, owing its activity to the nitric acid in its composition; though less powerfully caustic than that acid, it is better fitted for application to certain parts since it does not fume when exposed to the air. It is much in use for the destruction of lupous and rodent ulcers, and for the former of these it is a most convenient and efficacious application. The solution is best applied with a camel's-hair brush, the surface of the part being previously cleansed and dried: it is necessary to limit carefully the application to the diseased part, since the epithelial covering of the mucous or cutaneous surface affords an insufficient protection against the action of this caustic. It may be well to mention that cases of poisoning are recorded from the absorption of this substance applied as a caustic.

Arsenical paste.—The only active ingredient of this preparation is arsenious acid; this is diluted with various inert substances to the required extent. The arsenical paste most in use in this country is that first employed by Baron Dupuytren; it consists of a mixture of calomel and white arsenic, in the proportion of from six to ten parts, by weight, of the latter to a hundred of the former. This being made into a paste with mucilage or a little water may be applied to the surface of the parts either directly or spread on lint or a piece of blotting-paper. The efficacy of this caustic is undoubted in the treatment of lupous, rodent, and other intractable ulcers; but there exists the obvious objection to its use, that it cannot be employed on a surface of any considerable extent, on account of the danger of its absorption into the system. Indeed a case is related in the practice of M. Roux where the application during a single night of a paste, containing four per cent of arsenic, to a surface of little more than an inch in diameter proved fatal. Considerable and sometimes enduring pain follows its use, accompanied with no little irritation and inflammation of the surrounding parts, and the eschar is slow to separate. The arsenical paste is inert on surfaces protected by epithelium.

Terchloride of antimony, or butter of antimony as it is usually termed, is a substance possessing powerful caustic properties, though but little used in this country at the present day.

Butter of antimony is stated by Pereira to consist of a solution of the terchloride of the salt in hydrochloric acid; it is used for the destruction of syphilitic warts or condylomatous growths, and is recommended by Continental surgeons for application to poisoned wounds and the bites of rabid animals. The solution may be applied with a camel's-hair brush until a whitish slough is produced, when the surface of the part should be thoroughly washed to remove any remaining caustic.

Chloride of zinc forms the active ingredient of many of the most popular and effective caustics; mixed with variable proportions of flour it constitutes Canquoin's paste. It enters into the formation of Landolphi's caustic, combined with equal parts of the chlorides of antimony, bromine, and gold. More recently other adventurers have made use of the caustic properties of this salt, and by mixing it with pretended remedies for cancer have endeavoured to impose on the public, and conceal the uselessness of their supposititious specifics.

Chloride of zinc may be used in the form of solution by mixing one part of Sir W. Burnett's solution with seven parts of water, or as a paste in the proportion of one part of the dry chloride to two, three, or four parts of flour or plaster of Paris.* It is employed to destroy ulcerated surfaces, or to remove solid growths of various kinds: it should not be applied to any but an ulcerated, abraded, or denuded surface, as its action upon the parts protected by their epithelial covering is both slow and extremely painful. The solution may be applied on pieces of lint cut rather smaller in extent than the intended slough. The paste may be spread on lint in a layer varying in thickness with the depth of the part to be destroyed; in mixing the paste, the chloride will generally absorb sufficient moisture from the atmosphere to render the addition of spirit unnecessary. This caustic takes some hours to produce its full effect; the pain it produces is considerable, but not so acute or enduring as that caused by arsenical paste.

The slough when formed is whitish, dry, and inodorous;

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* This caustic, either in solution or in its solid forms, may be advantageously mixed with the hydrochlorate of morphia, which in a measure diminishes the pain attending the application.

there is little inflammation excited in surrounding tissues; and decomposition in the wound, if it previously existed, is at once arrested. Nor does the slough itself show any tendency to putrefy. A considerable advantage attached to the use of this caustic is the very contractile nature of the wound resulting from its application, a contractility which becomes evident some days even before the separation of the slough.

In attacking solid growths with the chloride, to save time in the subsequent progress of the case, it is usual after the first application, and so soon as the slough is fully formed, to make incisions through the dead parts; these being stuffed with shreds of lint dipped in the caustic solution, or smeared with the paste, may from time to time be deepened until the whole substance of the growth is destroyed.

Nitric, hydrochloric, and sulphuric acid, in a concentrated form, are the most powerful of the potential cauteries; their influence extends rapidly through the common integument of the body to the deeper textures; they will act upon any part of the surface to which they may be applied. In the liquid form no caustic is so suitable as one or other of the above named for destroying the surface of sloughing sores, or for the local treatment of hospital gangrene. Their effect on such a surface is decided, rapid, and, in the case of the monohydrated nitric acid, far less painful than is generally supposed: the resulting eschar separates quickly, and the surrounding inflammation is not excessive. In applying the strong acid to a sore, the surface of the part should be carefully dried, and the skin in the neighbourhood protected by being smeared with oil or simple cerate; and a glass brush, or a piece of cotton-wool or lint tied on the end of a piece of wood, may be used to bring the acid in contact with the surface of the sore.

For application to the sound skin, the concentrated acids are somewhat too diffuse in their action: with a view to obviate this tendency, they are mixed with various inert substances, and made into the consistence of a paste; thus sulphuric acid is mixed with powdered sulphur, saffron, or sawdust, and in this form it is far more convenient and manageable for the purpose above mentioned. The use of sawdust for this purpose originated with Mr. Syme, who also devised a most ingenious plan for protecting the surrounding surface, a method that can be adopted with great advantage whenever caustic is applied to the unbroken skin.

Mr. Syme gives the following account of the method in question: 'A solution of gutta-percha in chloroform is applied to the skin for some distance around the parts to be attacked; then a thick piece of the same material, with an aperture cut in it the requisite size, and softened by exposure to heat, is pressed firmly so as to adhere to the surface thus prepared; a thin piece is next glued around the edge of the opening, so that when supported by a stuffing of lint it may form a wall enclosing the diseased part. Concentrated sulphuric acid, with about an equal weight of sawdust stirred into it, until the mixture assumes a homogeneous consistence equal to that of thin porridge, is lastly applied, in quantity proportioned to the extent of thickness concerned.'

In the course of ten or twelve hours a slough will have formed, presenting the 'appearance of strongly compressed tow.'

For destroying the integuments, or denuding the surface preparatory to the use of some of the less active forms of caustic, Mr. Syme's mixture of sawdust and acid is specially adapted, or the caustic potash may be employed in the same way. Caustic potash, however, has the disadvantage of diffusing itself rapidly among surrounding parts; for this reason, with a view to confine its action, it is generally mixed with quick-lime in the proportion of five of the former to six of the latter, forming the Vienna paste, a more manageable and more active preparation than the pure potash.

Cautérisation en flèches.—In 1858 M. Maisonneuve drew the attention of the Académie des Sciences to a method of applying caustic for the destruction or enucleation of solid growths, and gave to his method the name at the heading of this paragraph. The caustic he employs for this purpose is a mixture of one part of chloride of zinc and three of flour, combined so as to form a thick paste. This being spread out into a flat cake, is cut into narrow lancet-shaped strips, or wedge-shaped pieces, of a suitable size; these are subsequently dried until they acquire sufficient consistence to be available for the purpose about to be described.

One plan of attacking a solid growth with this form of caustic is the following: the base of the tumour is surrounded at short intervals by radiating punctures, converging towards the centre and deepest part of the growth, and completely undermining the diseased tissues; these punctures are made with a double-edged scalpel, the flat of the blade being turned towards the surface of the surrounding skin, and each should be of sufficient size to admit of the introduction of one of the caustic arrows previously prepared; as each puncture is made, the caustic should be at once plunged into the track of the knife, and allowed to remain. In a period varying from ten to twenty days, the whole growth will generally separate, leaving a clean granulating wound.

In cases where the growth cannot be circumscribed in the manner above mentioned, but can only be approached from the surface, M. Maisonneuve plunges the 'flèches' in parallel lines into all parts of the substance of the tumour; or again, when it is important to preserve the skin over the site of a tumour, one or more of the 'flèches' may be introduced through a lateral puncture quite into the centre of the growth, the resulting slough being allowed to escape through the aperture of puncture.

As a more convenient and more ready form of caustic, Mr. Paget has recently made use of small lancet-shaped slips of wood dipped in fused chloride of zinc; these are more readily prepared, and far more easily introduced, than the flèches recommended by M. Maisonneuve. It is needless to do more than to remark that this plan of removing tumours by enucleation, which can only be required in exceptional cases, is an exceedingly painful process.

The actual cautery has already been alluded to in the consideration of counter-irritants: in its ordinary form it is but rarely used for other than its counter-irritant or styptic effects; but as the galvanic cautery, there are many and various purposes for which it may be advantageously employed.

The galvanic cautery.—This country is indebted to Mr. Marshall for the application of this most commodious and ingenious form of cautery; more recently Dr. Middeldorpff, of Breslau has refined, and as it were perfected, the mechanical appliances of the process; to his monograph on the subject the reader is referred for a full account of the mechanism and surgery of the galvanic cautery.* The cautery in question possesses its chief superiority over the more usual form of actual cautery, in the easily regulated intensity and the duration of the temperature employed; in the facility with which its mechanical form can be suited to the external circumstances and other requirements of various parts of the body; in the intensity of the heat produced by the galvanic current, the rapidity with which this is communicated to the metal employed as a cautery, and the possibility of applying the heat subsequent to the introduction and proper adjustment of the instrument to the parts to be cauterised. It cannot but be regretted that the expense of the necessary appliances, and the cumbersome nature of the apparatus, tend to confine the use of this form of cautery to the exigencies of hospital practice. Besides the more obvious and general use of this remedy in the treatment of sinuses and fistulæ of almost every kind, and as a counter-irritant or styptic, Dr. Middeldorpff extols its efficacy in the treatment of stricture of the urethra; for removal of polypi, amputation of the penis and uvula, removal of the tonsils, and even suggests its application for the amputation of entire limbs; indeed he allots to the galvanic cautery a more extended sphere of action than any but its most ardent supporters could concede.

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* *Die Galvanocaustik,* Breslau, 1854.

Platinum is the metal employed for localising the heat of the galvanic current, and for transmitting it to the parts to be cauterised. In all Dr. Middeldorpff's instruments an apparatus is fixed in the handle worked by a small screw, by means of which the galvanic current can be established or broken at will.

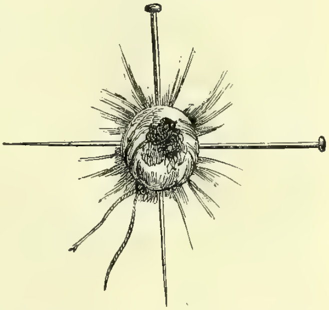
In treating fistulæ by this method, a platinum wire may be introduced into the track of the sinus, and being subsequently connected by its ends with the opposite poles of the battery, the cauterisation may be effected.

Dr. Middeldorpff has figured and described a very convenient and narrow-pointed platinum cautery, adapted to narrow sinuses or lacrymal fistulæ; in such cases he recommends the use of a small speculum to protect the surrounding parts. For the removal of tumours, polypi, and other outgrowing parts, a species of écraseur is provided; the chain in this instrument is replaced by platinum wire, which can be tightened at will by an apparatus attached to the handle. Again, for cauterising strictures of the urethra, Dr. Middeldorpff has invented a species of catheter, containing a concealed platinum point, to be projected and heated by an arrangement connected with the handle of the instrument. As a counter-irritant there is no superiority attaching itself to the galvanic cautery above the ordinary forms of actual cautery; but such as prefer to employ it may find in the work referred to above a description and figure of a small porcelain cone surrounded by a spiral platinum wire, expressly intended for the formation of caustic issues.

STRANGULATION OF NÆVI AND OTHER TUMOURS.

Nævi and some other small tumours may be strangulated by external or by subcutaneous ligatures. The most simple form of external ligature, and such as is well suited for small growths that are partly cutaneous and partly subcutaneous in their origin, consists in passing beneath the growth two fine hare-lip pins at right angles to each other. These should enter the skin clear of the nævous structure, and passing completely beneath its base, should emerge through the sound skin beyond; a piece of strong twine being wound around beneath the needle-ends, the growth may be strangulated and the whole secured by a double knot (Fig. 344). For convenience, the needle-ends may be shortened, and a strip of lint may be wound beneath them to protect the surrounding skin, the whole being left to come away by sloughing. By some the needles are made use of only to raise the nævus during the tightening of the ligature; being withdrawn just before the knot is tied.

FIG. 344.



Again, a good plan, and efficacious for small nævi, recommended by Mr. Cooper Forster, is to tie the nævus upon the pins, withdraw them, and four or five hours afterwards to cut or untie the ligature. The crushing which the nævus or its vessels of supply undergo in this process leads to the wasting and shrivelling up of the growth, which separates in two or three weeks in the form of a dry, scabby lump; the resulting cicatrix is less considerable than that left by the ordinary plan of external ligature.

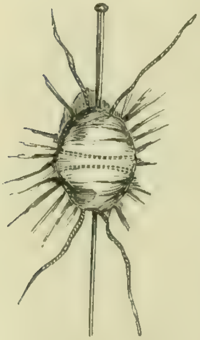
To lessen the pain of the ligature, and to hasten the separation of the slough, it is advisable to trace with the point of a small knife a groove in the skin in which the ligature may lie; this incision should run around the base of the nævus, connecting one needle-puncture with another. Some nævi, though of considerable size, are covered with sound skin, or a disproportionately small extent of this is affected. In strangulating such, before passing the ligature around the pins, a crucial incision may be made over the surface of the growth down to its base at the points where the pins pierce the integument; the four included flaps being reflected, the ligature is applied within them, so that after the separation of the slough they may in part at least, cover the denuded surface. It is probable however, that nævi situated at such a depth beneath the surface and with the integuments so little affected as to admit of this proceeding being adopted, would be more suitably treated by injection or complete excision.

Subcutaneous ligature.—For the convenience of description, under this term all such ligatures will be described as are passed subcutaneously, either around the nævus or beneath it, whether completely or only partially beneath the skin.

The partially subcutaneous ligature, which is ordinarily in use for mixed nævi of large size, may be so arranged as to strangulate the growth (*a*) in halves, (*b*) in quarters, or (*c*) in as many portions as its size or shape may require.

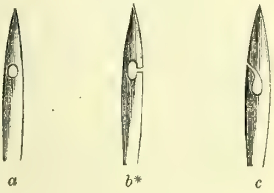
(*a*) For strangulating a nævus in halves, a strong stout needle, or one fixed in a handle with an eye at the point, being armed with a double thread, may be passed beneath the growth, so as to be quite clear of the nævous structure. The looped end of the twine being cut, the four ends may be grasped and used to raise the growth, while a pin is passed beneath it at right angles to the track of the ligature. The opposite ends of each portion of the ligature may now be tied together firmly beneath the end of the pin on the same side; the latter being shortened to a convenient length, the growth may be allowed to separate by sloughing (Fig. 345), or the pin may merely be used to raise the nævus upon during the tightening of the knot, and be subsequently withdrawn. It is advisable to divide the skin around the nævus in the track of the ligature, just before drawing the latter tight.

Fig. 345.



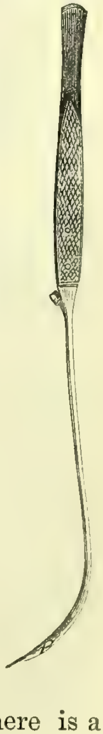
For carrying ligatures beneath nævi, besides the common needle (Fig. 346*a*) and that which has an eye opening and closing at will, shown in Fig. 346*b* and Fig. 347, there is a convenient needle, with a slit in the side of the eye, closing with a spring, from which the thread can be disengaged by simply pulling on the loop (Fig. 346*c*).

Fig. 346.



(*b*) Of the plans in use for tying nævi in quarters, there are two of almost equal efficiency; the one introduced by Sir W. Fergusson, the other recommended by Mr. Cooper Forster. The latter gentleman uses a needle with an eye near the point, which opens at will, so as to disengage the thread by pushing a button attached to the handle (Fig. 347). The needle being thrust beneath the centre of the nævus, and out at the opposite side, the eye is opened, and the loop of a long and strong piece of twine is introduced, and retained by closing the slit in the side of the needle, which is withdrawn, bringing with it the double ligature, one end of which is divided, and the other, being carried a quarter of the way round the nævus, is thrust with the needle beneath the growth at right angles to its former course. This thread is now detached, and one end of the other thread is passed into the needle's eye and withdrawn with it beneath the nævus; the skin being divided to receive the ligature between the points of perforation, the four ends of the ligature may be tied together two and two.

Fig. 347.



Sir W. Fergusson makes use of a strong curved suture-needle, having a large eye. This being threaded on the middle of a long and strong piece of twine is passed beneath the nævus, the double thread being drawn half its length out on the opposite side; the loop is now divided on one side of the eye of the needle, and the opposite end of the thread that was cut is passed into the eye. These two ends are then carried with the needle beneath the nævus at right angles to the former course of the thread; the four free ends can then be tied two and two, the skin having been divided in the track of the ligature (Fig. 348).

In addition to the proceedings above described, there is a method of strangulating a vascular tumour in four quarters, by passing beneath it at right angles two double threads in separate needles, and tying the eight ends together two and two in four knots. This plan is objectionable, as the thorough strangulation of the nævus depends upon the tying of the last two threads; when these are tightened, they frequently draw the knots of the other ends into the needle-holes in the integument, and thus prevent the complete strangulation of the growth.

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* The eye of the needle is here shown open.

(*c*) The shape and size of a nævus, or the external conformation of the part upon which it is situated, may be such that the above-described ligatures are unsuitable for effecting its strangulation; for such cases, especially where the growth is of oblong form, a thread may be passed beneath the growth at suitable intervals, and the included portions be separately tied up. For this purpose, a large curved suture-needle may be threaded on the middle of a long piece of twine, one half of which has been previously dipped in ink, or otherwise coloured. The needle may be passed beneath the growth at right angles to the long axis of this, at suitable intervals backwards and forwards, until the whole disease has been included between the threads. All the black loops of the twine on one side being cut, and all the white loops on the opposite side, each pair of white ends may be tied together on the one side, and on the opposite each pair of black ends (Fig. 349). If it be thought necessary, hare-lip pins may be used in conjunction with this suture, being passed at right angles to the course of the thread they may be used either to raise the growth during the tightening of the knots, or they may be left in situ until sloughing

Fig. 348.

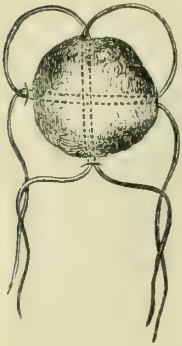
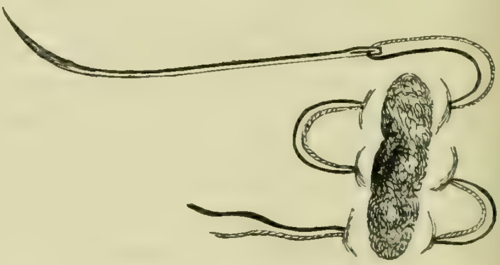


Fig. 349.



takes place, to insure that the ligature, in cutting its way through, shall pass completely beneath the disease.

Completely subcutaneous ligatures, when applied for the strangulation of vascular tumours, may be so arranged as to include the growth in (*a*) a single loop, or (*b*) in two portions.

(*a*) To strangulate a nævus with a subcutaneous ligature in a single loop. A strong curved needle carrying a stout ligature is passed into the cellular tissue, close to the nævus, and carried around the circumference of the disease as far as the needle will conveniently reach (of course the concave side of the curve of the needle should be turned towards the nævus in effecting this); the needle-point may then be protruded, and the ligature and needle drawn out, to be again introduced at the same hole, and carried onwards in the same direction, until the whole nævus has been surrounded, the needle being at last brought out at the point where it first pierced the skin (Fig. 350).

(*b*) To produce strangulation of a large nævus, it may be necessary to tie up each half separately; to effect this with a subcutaneous ligature, a double thread being carried beneath the base of the growth, the loop on one side of the eye of the needle may be divided, and each end of the thread be carried separately back beneath the skin, round the opposite semi-circumferences of the growth; the needle being introduced at the former point of exit, and emerging where it first pierced the skin. The opposite ends of the same threads being tied together, the two halves of the nævus will be separately strangulated (Fig. 351).

Fig. 350.

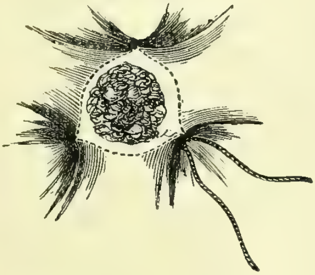
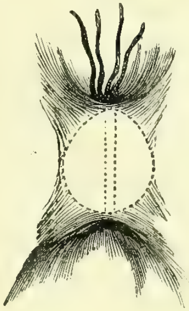


Fig. 351.



THOMAS SMITH.

PLASTIC SURGERY.

ABOVE three hundred years ago there lived in Bologna a physician of the name of Gasparo Tagliacozzi, who excited far and wide attention and wonderment by his operations and cures. Some regarded him as a sorcerer and necromancer; others as a liar or boaster. No one, however, could comprehend how he accomplished his wonderful cures. Equally little could any one prove aught evil in his actions or behaviour; for he was a man much respected in Bologna; he was Professor of Anatomy and Medicine, beloved of all students, and so honoured by his fellow-citizens that they erected to his memory after his death, in the anatomical theatre at Bologna, a marble statue with this insignia of his art—a nose—in his hand. But he had thus far a connection with 'necromantic' arts. Before his time surgeons, as occasionally in the present day, had sought to obtain eminence by cutting off arms and legs, by boring the skull, and by burning and cauterising the flesh. He, however, regarded the matter in a different light; for far from taking anything away from his patients, he endeavoured, and found a pride therein, to replace parts which had been lost to them,—namely the nose, lips, and ears,—and that not by wood, pasteboard, silver or gold, but (as was at least then currently believed) by true veritable flesh. There needs no extravagant fantasy to imagine what notice and envy he thus excited, and how he drew upon himself satires both in prose and verse; the more so because his art was regarded as a mystery, and no one could accurately understand whence he obtained the new flesh. So much, however, seemed certain to all, either that he obtained a real human nose taken from another person, or that he cut the organ from some tender flesh, either from chickens or calves, and patched it on the mutilated persons. Tagliacozzi, however, disdaining to spread about himself or his art a mystery, wrote, in the year 1597, a large work in folio, *De Chirurgia Curtorum per insitionem*, wherein he opened the eyes of people how and whence he made these artificial pieces, namely out of skin. The well-known lines in *Hudibras* have become trite, meaningless, and vulgar; while Tagliacozzi's experimental confirmation of a great physical truth lives to be only more honoured and believed.

It is no refutation of the claims of Tagliacozzi to say that surgeons are often disappointed in their expectations ; that the descriptions given by the early apostles of plastic surgery were florid or exaggerated. The fundamental truths remain the same ; the transplantation and reunion of flaps of integument is a proceeding adopted and recognised by all surgeons, although they have learnt that the ultimate result is generally of no more favourable character than to warrant the proceeding in cases where the patient experiences a positive evil. We do not quite accompany Dr. Fritze,* when he says, in his glowing language, 'A perforated and corroded fleshy knob, which brings woe to the possessor who carries it on his shoulders, and horror to every one else, is converted by plastic surgery into a human physiognomy, and gives back to the discarded and avoided person both life and society ; the eye, which, deprived of its natural covering, becomes dry and inflamed, and would withdraw itself, but in vain, with convulsive efforts, from the destructive influence of light and air, seeking the repose which avoids it, is covered again with protective eyelids, and regains life and sleep ; a mouth, puckered up and grown together like an eyelet-hole, for which no food is suitable save soup and thin broth, and whose expulsive articulation resembles the cry of the wild beast, again gives forth human sounds, reopens, and allows the patient both to eat and speak. Have I yet,' he says, 'occasion to relate that plastic surgery has the power to heal both urinary and fæcal fistulæ, and thus to remove the greatest physical suffering with which man is afflicted in this world ?' † Let us divest the subject of this high colouring and romance ; and, while acknowledging its utility, remember that 'the artificial nose, even the most complete, can never fully equal the natural ; that the patient need never expect it.' 'Nature ever triumphs over art, and here is the boundary between what is godlike and human.'

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* *Die Plastische Chirurgie,* an excellent work, to which the reader may be referred for a history of the art of Plastic Surgery.

† Op. cit. p. 3.

Certain subjects, those indeed most commonly illustrative of plastic surgery, will in this work be treated under other heads. Thus, fissured palate, &c., comes under the head of Diseases of the Mouth; entropium, ectropium, and closure of the lacrymal sac, under that of Diseases of the Eye; imperforate anus, under Surgery of Childhood; recto- and vesico-vaginal fistula, under Diseases of the Female Organs of Generation. We propose, therefore, here to deal more with general principles, and to apply them to such subjects as are not included in the above headings.

Now all deformities, whether remediable or irremediable by surgical operation, may be classed under two heads: the congenital, and the non-congenital; and this distinction must be borne in mind in most of the cases we are called upon to treat. A congenital deformity implies an arrest of development, possibly a congenital deficiency of parts, or a relation such as should exist naturally only in fœtal life. In the non-congenital or acquired deformity, parts already formed and normally proportioned have been injured or destroyed. There are but few exceptions to this rule. The treatment of the former is in severe cases more unsatisfactory than that of the latter. For instance, a simple congenital fissure of the lip, constituting hare-lip, may be united in the usual way; but there is mostly some abnormal marking on the integument, which ever afterwards indicates the operation which has been performed. Moreover, the fissure may extend into the hard and soft palates or the irregularity of development may influence the position of the incisor teeth. The case is obviously more complicated than one of simple division of the upper lip by accident or surgical operation; and the surgeon should bear this point in mind; for although, as regards the mouth, the statement is obvious enough, there are other situations where want of attention to the law of fœtal relations may be followed by serious consequences. When the bladder is open in front from congenital defect (extroversio vesicæ), the fissure in the organ and in the abdominal parietes is not the only defect. Bladder, prostate gland, and peritonæum, rectum and pelvic bones, retain very much of those relations which existed at the moment when the bladder failed to close. In other words from that moment parts grew in size, but ceased to be developed to the normal bearings of the adult. Should the surgeon in such a case endeavour to establish a recto-vesical fistula (as has been several times attempted), by passing a trochar from the rectum into the bladder in order to divert the stream of urine, he will make the discovery that there is rarely any safe spot which the instrument may traverse: the prostate gland is small; the peritonæum comes down to its very border, as it would in the young infant; the bladder is more of an abdominal than a pelvic viscus. Hence fatal peritonitis ensues before the surgeon has had time to establish those conditions which he trusted would enable him to close, by a plastic operation, the abdominal fissure through which the urine escaped.

The powers of repair and of reproduction in man, upon which depend the success of all plastic operations, are very much more limited than in the lower animals. We need not here dwell upon the well-known instances of the re-formation of the lost leg to the salamander or the lost claw to the crab, but may remark that in man the hair, the nails, the epidermis, and epithelium seem alone to possess the power of complete regeneration. It is doubtful if, under any circumstances, tissues of even the lowest organisation and of the lowest chemical characters, such as the cellular and tendinous, become replaced completely, when once removed, with all the characters they had before. In 1858 I had the opportunity of examining two Achilles tendons, which had been subcutaneously divided at periods of two and three months previous to the death of the patient;* and it was there seen, after making a longitudinal incision, that the divided ends of the normal tendo Achillis, two inches apart, were united by a light gray semi-transparent structure, quite different from natural tendon, and readily distinguishable to its very boundary.

Whatever the microscope may reveal, the fact is undoubted, that when the entire thickness of the skin has been destroyed, the tissue which replaces it never exhibits the same characters or perfection as before. A superficial layer of skin may be disorganised, when repair goes on by granulation, and no trace of the injury after a time is perceptible. But the case is otherwise when the whole thickness of the skin has perished. The smooth white cicatrix retains its own characteristics, and contracts for months and even years, gradually drawing closer around its decreasing circumference the surrounding integument, and acting, though slowly and gently, yet with a force that no tissue, however hard, can resist, distorting the features, and exercising an influence on the shape of the growing bone and on the direction of the teeth. Let no surgeon, who hopes to remove a deformity, ever trust to the persistence of a large cicatrix; let him likewise remember that every incision which he makes involves the formation of this newly effused and readily contracting uniting medium; and he may perhaps be more wary than he has hitherto been in attempting the removal of contractions by operation.

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* *Medical Times and Gazette*, January 9, 1858.

In plastic surgery the operator avails himself of the true skin, with the subcutaneous areolar and fatty tissues; sometimes likewise of the mucous membrane. Fritze justly remarks that the transplantation and union of bone-fragments, as well as of teeth and hair, is very problematical. Walther[*] speaks of the reunion of a piece of trephined bone; Weisemann,[†] of the adhesion of teeth; Dieffenbach, of the transplantation of hair. Hunter's experiments upon this subject are also well known. They are all, however, of more physiological interest than practical utility.

'We have to deal in plastic operations with the integument only,' says Fritze; [‡] 'and can as little make a new nose out of a fowl's breast, as cut out and form a similar organ out of the thick muscular flesh of the arm.' The flap for transplantation should be taken from the individual on whom the deformity is to be rectified. Thus, if a new nose is to be formed, the skin should be taken either from the immediate proximity of the damaged organ, as the forehead or cheeks, or else from a part which can be readily approximated, such as the forearm. Bünger relates a case of partial success in the formation of a new nose on a lady by a piece of integument completely cut away from the thigh; [§] and Hoffacher, who was officially appointed to attend at the duels frequent among the students at Heidelberg, mentions some remarkable instances, which are attested by Chelius and Velpeau, of the reunion of parts completely sliced off by sword-cuts; *e. g.* portions of the nose, lips, or chin. But no such license can be allowed in plastic surgery; the flap must retain its connection to the adjacent living structure by a pedicle, which is to be severed only after complete union and cicatrisation of the raw surfaces. The idea of taking the flap of integument from another individual, and binding the two persons together until union shall have taken place, is preposterous to English notions; although stated to have been entertained and practised in eastern countries, where plastic surgery has been known from time immemorial.

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[*] Th. v. Walther, *Wiedereinheilung der bei der Trepanation ausgebohren Knochenscheibe.*

[†] J. H. Weisemann, *De Coalitu partium a reliquo corpore prorsus disjunctarum*, Leipsiæ, 1824.

[‡] Op. cit. p. 5.

[§] Bünger, *Gelungener Fall einer Nasenbildung aus einem völlig getrennter Hautstücke aus dem Beine.* See Gräfe und Walther's *Journal*, Bd. iv. p. 569.

The flap of integument, separated from its connections by the knife, and hanging only by the pedicle, becomes at first blanched and white from loss of blood, and also somewhat shrivelled or shrunken. After the hæmorrhage has ceased, it may acquire a marbled aspect from irregular accumulation and stasis of the blood; and the temperature perceptibly falls. Soon, however, the redness and warmth return to it in its new situation, and hæmorrhage may commence from its under surface afresh. Thus it continues for some hours, the flap sometimes paler, sometimes redder, as the vitality loses or acquires power, until ultimately, when circumstances are favourable, the latter condition prevails, and even puffiness and swelling may supervene before the parts regain their normal aspect.

Now, inasmuch as the success of all these operations depends upon delicacy of manipulation and extreme accuracy in detail, let me warn the student that there is no more frequent source of failure than the presence and persistence of a clot of blood, whether primarily or secondarily effused, under the flap. Hæmorrhage is an evil in all stages of plastic surgery; and therefore the surgeon is accustomed to wait before attaching the bleeding flap to its new connection, well knowing that no time is more favourable for the effusion of plastic material than when the parts are dry and even somewhat glazed. He likewise keeps the patient moderately cool, maintaining the natural heat of the body on one hand, and avoiding all causes likely to produce excess of action on the other; for should bleeding recur, the wound may need to be reopened.

Among the accidents which befall the transplanted flap is one to which particular attention has been directed by Mr. Skey.*

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* Skey, *Operative Surgery*, 2d. edit. p. 524.

'It will occasionally happen,' he observes, 'after some days from that of the operation, that the new structure begins to lessen in size, and continues to diminish, till it becomes almost absorbed. My experience in nose-making, though not small, is not sufficiently great to enable me to explain this fact; whether owing to the small size of the stalk, or to the want of general activity in the circulation,—but such is the case.' That the shrinking of the flap is rather due to the latter than to the former cause, was illustrated by a case under my own care in St. Bartholomew's Hospital. In 1859, a boy was admitted suffering from disease of the knee and symptoms of early tubercular deposit in the lungs. I amputated the limb according to the method proposed by Mr. Teale; that is to say, by making a long rectangular anterior flap of integument, and bringing it under the stump to unite with a short flap at the posterior aspect of the limb. The case terminated favourably; but with the cicatrisation of the wound the anterior flap shrunk so considerably, that it but little exceeded in size the smaller posterior one to which it had been united. The limb had the aspect of having undergone the usual flap operation.

Gangrene appears about the third or fourth day. If the flap retains its vitality beyond this time, union generally proceeds without interruption. The parts assume a grayish colour when mortified, look soft and pulpy, and the cuticle loosens; or the flap may become dry, shrivelled, and withered. But even under these circumstances let not the surgeon remove it; he should rather cover it with cotton wool or a soft bread-and-water poultice, or with water-dressing, *i.e.* wetted lint covered with oiled silk or gutta-percha; for he cannot tell either how far or how deep the loss of vitality may extend. The edges of the wound alone may die; or the superficial parts may be thrown off. If even the smallest portion of skin remain in its new situation, it will afford the patient partial relief, or serve as a groundwork materially to facilitate any future proceedings. I will add only this advice: if the wound happen to be going on unsatisfactorily, the surgeon should cover it up, and abstain from frequent examinations. He will see in a few days, without repeated inspection, how much nature has been enabled to effect.

It is unnecessary to speak of the many inconveniences attending an attack of erysipelas after the operation, inasmuch as this disease has been described elsewhere. Every proper precaution should be taken to prevent such an accident: the room should be clean and airy; the dressings light, and easily though not often changed. The general condition of the patient should be such as to render unnecessary purgative or other disturbing medicines; he should take such nourishment as his circumstances best admit. By preserving the standard of health as near as possible to its normal state, we put the patient in the best condition to resist injurious morbid influences.

The object of the surgeon in all cases is to obtain union by *first intention*. The surfaces which we wish to unite should be held accurately together, with the smallest amount of irritation, until a layer of plastic lymph is exuded; an event which takes place at any time between twenty-four hours and three days.

The flap of integument having been cut to the proper size, cleaned of extravasated blood, and fashioned to its new situation, we proceed to inquire into the best method of holding it there until nature has accomplished her part. Although the employment of metallic sutures is not a modern discovery, yet too much credit cannot be given to Dr. Marion Sims for his energetic advocacy of their use, and for the earnestness with which he has worked out their practical application. Indeed they may be said to have fallen into disuse until the publication of his anniversary discourse before the New York Academy of Medicine.* Few surgeons will fail to endorse his opinion, that 'in plastic surgery it is the great desideratum.' 'In May 1850,' he observes,† 'a gentleman had the misfortune to lose a good part of the left ala nasi. In the operation eight interrupted silver sutures were used. They were removed on the seventh day: union was perfect, and he soon went home, with some slight tumefaction of the parts, which gradually subsided. In the course of a fortnight he returned, saying that in wiping the perspiration from his face, he discovered some pricking substance at the seat of the operation, which he supposed to be a bit of wire. He was right; the wire was there, but easier felt than seen. It was removed, and found to be half an inch long; it had remained there four weeks, producing no sense of soreness, and no inflammation or suppuration, as a silk ligature would have done; thus establishing the great and important principle that silver was as innocuous as lead, and, like it, might become sacculated, producing no irritant or poisonous effect whatever.' In 1852, a little boy, some eight years old, received a blow on the upper lip, near the left commissure, cutting it through for three-quarters of an inch. Three interrupted silver sutures were applied, and no other dressing. Dr. Sims saw no more of him till the ninth day: 'union was perfect, the wires remaining precisely as he had placed them. Their removal was like that of a delicate ear-ring from the ear long used to wear it.' In 1853 the same surgeon performed a serious operation on a gentleman suffering from cancer of the lip. The patient went home (some 80 or 100 miles) immediately after the operation, and returned to Dr. Sims in a week. The cut surfaces of a V-shaped incision had been united by four interrupted silver sutures: union was perfect throughout, the wires having pro-produced no inflammatory effect whatever.

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* *Silver sutures in Surgery*; the anniversary discourse before the New York Academy of Medicine, delivered on November 18, 1857, by J. Marion Sims, M.D., Surgeon to the Women's Hospital: New York, 1858.

† Op. cit. p. 32.

The method of introducing the wire sutures has been already described;* the time of their removal must be left to the discretion of the surgeon; probably the mean time would be about a fortnight.

The shotted suture is no modern invention. Two or more pieces of silver wire are passed across any deep wound, at equal distances from each other, by means of a slightly curved needle. The two extremities of each wire are passed through a small hole drilled in a bar of plated metal, the length of which should exceed that of the wound. The wires are first fixed beyond the bar, on one side of the wound, by means of perforated shot, about two of which may be strung on each wire, and compressed by means of a pair of pliers. The opposite end of each wire being now strung with perforated shot, the wound is drawn together, the shot pushed up to the bar and compressed, as on the other side. The superfluous wire may be cut off with the cutting-pliers.

Rhinoplastic Operation.

Tagliacozzi's operation for making a new nose was as follows. After proper preliminary measures regarding the general health the patient was made to sit during the operation, supported by an assistant; the operator stood in front. The piece of skin to be transplanted was taken from the left upper arm, over the biceps muscle. The surgeon raised the skin by means of a pair of broad-bladed forceps, of somewhat peculiar shape;* and when he had satisfied himself that he seized a piece of sufficient size, he closed the blades, and fixed the handles by means of a simple clasp. He then passed a double-edged knife through a horizontal fissure in the broad blades of the forceps and through the skin, thus separating the latter from the subjacent muscular tissue, but leaving it attached by a pedicle, both towards the shoulder and the forearm. A piece of lint soaked in oil or simple cerate was inserted under the flap, to prevent union from taking place; and it was retained in its position under the skin till the fourth day, when the dressing was changed, and renewed daily until suppuration was established. If the flap had then begun to thicken and the edges to become incrusted, it was cut free at its upper end, presenting a line with the convexity directed upwards. It was then most carefully dressed and attended to, until the under surface had become cicatrised as far as possible. Remaining attached by one extremity to the arm, it underwent a process of thickening, contraction, and wrinkling, accompanied with the growth of hair, which Tagliacozzi fancifully compared to different stages of growth. About the fourteenth day after the second operation, it was considered to be in a state of maturity. The patient was purged, cleanly shaved, and supplied with a leather jacket, which was to serve as a support to the arm when raised to the face. The jacket, or jerkin, consisted of a cap and of a breast-piece. The edges of the flap and of the nasal aperture were then pared, and the two parts were prepared for union by sutures.

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* See Minor Surgery, p. 519. All the common forms of suture will be found described in that essay.

The arm rested in a semiflexed position, on a cushion, while the ligatures were being inserted and tied: it was retained in that position by a leathern apparatus, the different parts of which were attached to the cap and breast-piece by bands and straps. The patient was kept in bed, under a strictly antiphlogistic treatment. The ligatures were taken out on the third to the fifth day; but the flap was left resting upon some lint or rag covered with albuminous material until the twentieth day. The surgeon then loosened part of the arm-straps, severed the remaining attachment of the flap to the arm, and covered the wound with proper dressings. If the septum nasi was deficient, a piece was taken from the upper lip by a subsequent operation.

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* See Fritze, op. cit. plate ii. fig. 1.

According to the spirit of the age in which he lived, Tagliacozzi invested the stages of the operation, the instruments and apparatus, with unnecessary names; he is likewise tediously minute in his description, of which the above is a very brief outline. But he has a fair claim to the renown which has attached itself to his name, for the boldness with which he instituted his proceedings, and the care with which he followed his cases to their completion. Many have attempted to adapt the different stages of Tagliacozzi's operations to the ideas of modern surgery; but I think we may affirm, that the practice of taking the integument from the arm is exploded, and that in all cases the surgeon now prefers to avail himself of the parts adjacent to the nose, namely the forehead or cheeks.

Among those who have performed the rhinoplastic operation with skill and success, Mr. Skey holds a prominent position. The disease to which the destruction of the nose may be usually assigned is lupus, which, having involved the cartilaginous structure, leaves the bone untouched. 'If the bones be entire,' he says, 'the operation is more likely to be a successful one. If the bones be destroyed, the condition of the patient precludes the resort to the best operation, and the result is far less promising, from the loss of the arch on which the superstructure is laid.' *

Before proceeding to the operation, the surgeon should take the dimensions of the required organ in card, paper, or gutta-percha. The new material is taken from the forehead, and connected to the root of the nasal bones by a narrow stalk-like process. When the flap of the integument is insulated, this stalk is twisted, so as to enable the part to be brought down vertically. The integument, continues Mr. Skey, should be removed longitudinally from either half of the forehead, running outwards towards the temple, in order to render the twist as inconsiderable as possible; and when the admeasurement is complete, at *least a quarter of an inch on all sides* should be allowed for the contraction of the skin: in fact, the flap can hardly be made too large, and it is surprising how slight a stalk is requisite to carry on the circulation. When the card has been fitted over the meatus, it should be laid out on the forehead, and all its dimensions extended and marked in ink. The part that is to represent the columna should be very broad, probably more than half an inch. Mr. Skey puts the patient in the horizontal posture. He commences by paring the margin around the nose pretty freely, in order that the exposed edge should be sufficiently large to receive the corresponding margin of the new integument; and the skin on the lower surface of the ossa nasi should be entirely removed by the knife. When this stage of the operation is completed, a deep incision should be made along the inked line on the forehead, slowly and cautiously, for one slip of the knife may render the whole operation nugatory. The lower edge of the incision will pass across the fibres of the corrugator supercilii, which muscle may be detached with the integument. If the knife be so held as to slope a little inwards, it will give an acute angle to the cutaneous surface of the flap, by means of which the two surfaces may be adjusted with more precision as regards the continuity of surface. When the flap is detached in every part except at the stalk, which of course is most carefully preserved from injury, the wound should be left to bleed, and no attempt made to adapt the surface until the bleeding has *entirely ceased.* Before leaving the flap, it is better to scoop out a little of the substance along the central line of the columna, in order that, by being hereafter compressed, it may fold together and resemble as much as possible the original structure. When brought down, the columna should be first united to the raw surface made for its reception. There is some difficulty in applying the suture in this situation, from the density of the structure forming the base of the nose. For this purpose, a much-curved needle must be employed, which should embrace a considerable piece of the cartilage. It may be advisable to employ two sutures instead of one. The sides are then first united by about three good-sized sutures, and the intervals adjusted as exactly as possible by the aid of six, eight, or ten of the finest sutures that can be employed (fine silver-wire sutures are now used). The nostrils should be elevated by means of pieces of cork and cotton wool, and generally pressure of moderate force made laterally by the same material and a bandage, care being taken to prevent all pressure on the dorsum. The wound on the forehead should be drawn together with good plaster. At the expiration of about a month, or as soon as the new parts have firmly united, the lump, always caused by the twisting of the stalk, should be pared away, and the knife applied to remedy any positive deformity in the line of the cicatrix.

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* Skey, *Operative Surgery*, 2d edit. p. 521.

This operation of bringing the flap from the forehead is designated the Indian operation, and was first introduced into Europe by Mr. Carpue in 1814, who improved upon the original operation by adding a septum nasi, and by the employment of sutures. He was soon followed in Germany by Gräfe, by Dieffenbach, and by others; and the results have been successful. At the end of three or four days the flap will be found tumid, warm, and sensitive, but pale; and at this time, Mr. Erichsen recommends that the plug in the nose be changed, lest it be rendered offensive by the discharges. He rightly, however, adds, 'that its withdrawal, and the substitution of another, must be done with the greatest gentleness, the surgeon bearing in mind that any undue pressure or traction may destroy adhesions, and prove fatal to the vitality of the flap.'

Some surgeons make the columna nasi in the operation from the upper lip, as in the method proposed and adopted by Tagliacozzi. In cases where there has been great destruction of the bones, or where, as after syphilitic disease, the nose becomes completely depressed, Larrey and Dieffenbach have revived the operation of Celsus, and have taken the integument from the cheeks. 'A young girl had lost the proper bones of the nose, the vomer, the greater part of the nasal apophysis, the malar bones, and the lamellæ of the ethmoid. The integuments were folded into the nasal fossæ, and presented the general aspect of a countenance sunken by death. Dieffenbach made along the sides of the depressed nose, in its whole length, two incisions penetrating to the bone. There resulted a band of skin, isolated, and adhering only at the upper and lower ends; it was broader in the latter than the former: a vertical incision along the middle line divided this portion of skin into two. The lateral incisions were continued inferiorly by two semilunar incisions, which separated the alæ nasi from their external connections. He dissected these two flaps from below upwards, separating them completely from the nasal cavities into which they had been folded. He then separated, for some distance, the thick substance of the cheek. Having completed these steps, he united by six sutures the edges of the median incision, and brought into contact the edges of the lateral incisions by eight sutures. The nose then seemed to regain some of its natural prominence and form, the nostrils being kept distended by pieces of lint soaked in oil. As the last stage of the operation, he approximated the separated and dissected cheeks, under the nose, by passing through their substance a long needle.'* We mention this operation, not in terms of commendation, but rather to show what has been attempted and done with some share of success. We must, however, warn the young surgeon that, in these *opérations de convenance*, the sources of mishap are numerous, and disappointments will occur in spite of the endless variety of modifications adopted by different surgeons. Mr. Skey gives a good piece of advice when he says, 'let it be the patient who urges the operation.' The operator will be thus released of some share of responsibility. 'In one of Mr. Liston's early cases, the new nose sloughed under an attack of inflammation; in another, hæmorrhage occurred under the flap, on the ninth day, to the extent of more than a pint of blood. Lastly, the operation is not without its dangers: Dieffenbach lost two patients out of six on whom he operated in Paris, their constitutions being probably in an unfavourable state.' †

In the construction of a new ala nasi, the surgeon takes the integument from the cheek. He must trust to his skill, and the circumstances of the case, to guide his incision.

Cheiloplastic Operations. Operations for Defects of the Lips.

Hare-lip.—The well-known deformity called hare-lip is a congenital fissure of the upper lip. I never met with a case in which the under lip was similarly affected; but a few such cases are on record. The fissure may be single, generally a quarter or a third of an inch from the mesial line—more often according to Malgaigne, to the left than the right—and presenting at the lower angle a rounded and cicatrised appearance, which must be removed at the time of operation. Or it may be double, in which case there are two fissures, separated by a median flap. The deformity may be complicated with fissure of the bony or of the soft palate; the fissures in the former may be double. There may be fissures of the soft palate without any corresponding cleft in the lip.

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* Malgaigne, *Méd. opérat.* 1843, p. 421.

† Erichsen, *Science and Art of Surgery*, p. 670.

The piece of bone behind the median flap in double hare-lip and double fissure of the palate is said to be the homotype of the premaxillary bone in the lower vertebrata, and it generally contains the two front incisor teeth. Its size and the amount of projection vary considerably, but it is always a source of operative complication.

We do not propose to enter into the subject of arrest of development to which this deformity is due, but remind the reader of the statement already made, that in very many cases there are other congenital deficiencies coexistent. Among these rank foremost the teeth, which are often a source of subsequent trouble. I had under my care an infant with fissure of both hard and soft palate, double club-feet, with deficiency of the extensor muscles, and want of muscular power in both hands. It is obvious that in such cases surgical interference should be postponed.

The treatment of hare-lip is of very ancient date. We propose to confine the following remarks to the best mode of rectifying it as at present practised. The operation should be performed as early as possible, certainly before dentition has commenced. The closure of the fissure not only gives to the child the facility of sucking even immediately after the operation, but leads also to greater regularity in the development of the teeth. Delmas operated two hours after birth! Mr. Lawrence has often operated between the third and fourth week. I have frequently done the same. Sir W. Fergusson recommends about the sixth week, which Mr. Erichsen regards as the time of election. Mr. Skey doubts the advantage of its being undertaken at a period earlier than three or four months. Richter and Bell recommend a still later period. But if the child is strong and well nourished, a month or six weeks is about the proper time. Chloroform should of course be given, as infants become readily affected, and, as far as experience goes, with the smallest amount of danger.

Operation.—The child having been swathed in a piece of sheeting, and the lips being held by an assistant, who grasps them in their whole thickness to prevent hæmorrhage from the coronary arteries, the surgeon first finds it necessary to separate the mucous membrane and frænum with a scalpel from the alveolar border of the upper jaw, in order that the edges may be the more easily approximated. He then seizes the lower angle of each of the sides with fine sharp-pointed spring forceps, and either with a sharp knife or with knife-bladed scissors pares the edges effectually. Without waiting for the cessation of hæmorrhage, which would blanch the infant, the surgeon then passes the hare-lip pin deeply through the substance of the lip, commencing from one-third to one-half of an inch from the cut surfaces. A strong silken thread is wound round the pin, bringing the cut edges into contact, in the form of a figure of eight. I then prefer to introduce a fine silver suture at the upper end of the wound to bring the nares into shape, and a second at the red of the lip to preserve the continuity of that important feature. The child is allowed to sleep, or to suckle if it pleases.

Most surgeons prefer the two sutures to the practice of introducing a second hare-lip pin, because the former hold the parts more immovably in contact. I operated some time ago on a child, in whom I omitted to put the suture near the nares. Soon after the operation catarrhal discharge from the nose came on; the silk round the hare-lip pin became softened and loose before its time, and the fissure partially reopened. Mr. Lloyd was in the habit of preserving a small slip of the flap of the long half of the lip (when such inequality exists), and of attaching it to the under surface of the shorter half, that there might be no notch or fissure when cicatrisation had taken place.

Mr. Skey observes: ‘In consequence of the greater extensibility of the lower than the upper part, the result of the operation for hare-lip is to leave a permanent deformity, caused by the retraction of the cicatrix, and the formation of an angle below, at the point of union. To obviate this evil, the lines of incision should be curved inwards.’ * Different ways of varying the incisions, suitable to each particular case, must suggest themselves to the surgeon's mind before he commences his operation. The wedged-shaped slip depicted Fig. 352 preserves the continuity of the red of the lip.

The proceeding of Clémot (de Rochefort) and of Malgaigne (Fig. 353) also merits attention. The incisions are made from above downwards, but they do not completely detach the flaps.

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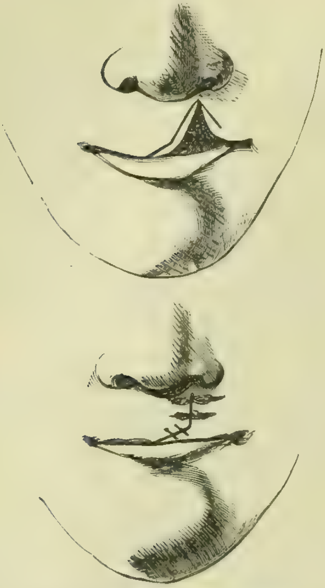
* *Operative Surgery*, p. 531.

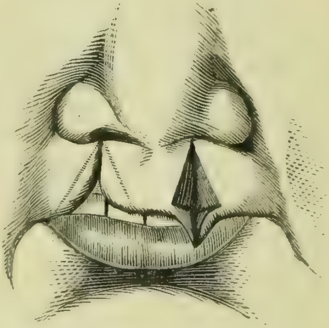
The exposed and everted surfaces are brought together, as are the other cut surfaces, and if the tubercle which results is too prominent, it is removed at a subsequent operation. But the parts once united shrink and adapt themselves to their new relations.

Fig. 352.



Operation for hare-lip with unequal sides, by leaving one of the pared edges (that on the left side) attached, and implanting it into the opposite flap, the edge of which has been sloped to receive it. (From Holmes's *Surgical Treatment of Children's Diseases.*)

Fig. 353.



Operation of Clémot or Malgaigne. (From Larcher's translation of the above work.)

Fig. 354.

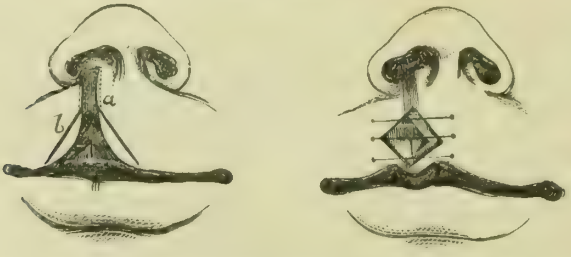


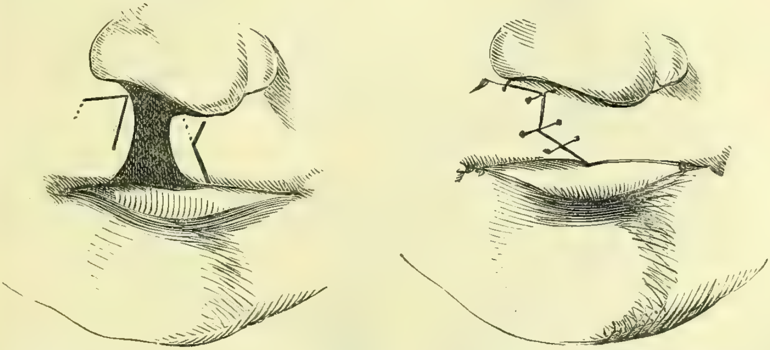
Diagram of an operation for incomplete hare-lip. Each flap is left attached to the other at its base, the incisions *a*, *b*, not reaching to the red edge of the lip. [N.B. In practice these incisions are not carried so low as they are here represented.] (From Holmes, op. cit.)

A third operation is represented by Fig. 354; a fourth (Fig. 355), that of Giraldès, enables the surgeon to bring forward a portion of the cheek, and to prevent undue tension. Further information on these operations may be obtained from Mr. Holmes's work on the *Surgical Diseases of Children*, or from the French translation of the same work by Dr. O. Larcher.

The hare-lip pin should be shortened at both ends by means of cutting pliers. Some surgeons have omitted the pins, and substituted the silver sutures; but, although union may be thus obtained, I am of opinion that a part so movable as the upper lip requires the firmer support of the strong metallic pin.

It is customary to remove the hare-lip pin about the fourth day. It should be gently withdrawn, and if the dried figure-of-eight piece of silk remain adherent, it may be left on the lip, where it serves as a plaster. There are some who remove the pin on the third day; others who leave it till the sixth or seventh. In the one case the union may be still too weak to hold; in the other, the pin may have cut its way out by ulceration. If the sutures are of silk, they should be taken away in twenty-four to forty-eight hours; if of silver, they may remain as long as the surgeon thinks proper. At the time of the removal of the hare-lip pin, the cheeks should be well pressed towards the middle line by an assistant, that no accident may occur to the newly-united parts by the act of crying which commonly ensues. Then a long piece of adhesive strapping, a quarter of an inch wide and three-quarters of a foot in length, should be passed, across the wound, round the head just over the ears two

Fig. 355.

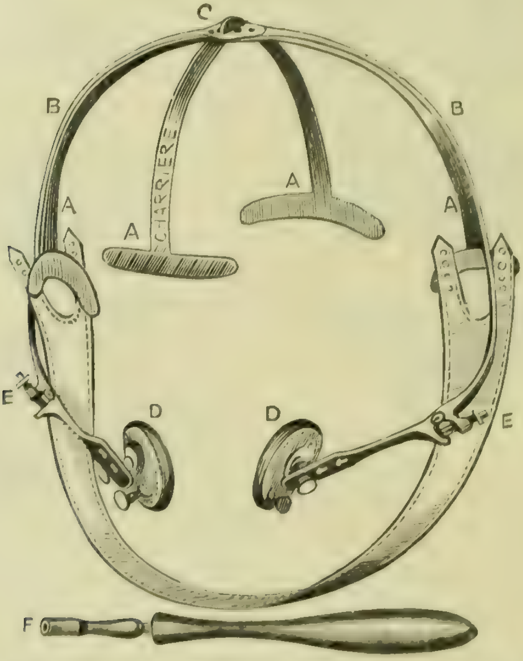


Giraldès' operation for complicated hare-lip, in which one flap is left attached by its upper, and the other by its lower end, and the two are dovetailed together. (From Thévenin, *Considérations sur le Traitement du bec-de-lièvre compliqué.*)

or three times, by which the parts are protected against all strain. I think the strapping preferable to Mr. Hainsby's spring cheek-compressor (Fig. 356); but the instrument accomplishes satisfactorily the same purpose.

In cases of double hare-lip it is safer practice to operate on and to unite the fissures separately. Some surgeons, however, have recommended that both fissures should be pared simultaneously, and that the hare-lip pins should be pushed through the central flap. Such a proceeding unnecessarily increases the chances of accident. When the bone containing the incisor teeth projects so far forward as to interfere with or to prevent the easy apposition of the pared edges of the lip, it may be cut away by bone-pliers at a separate operation; and this measure is not uncommonly necessary. But in many cases gentle pressure will make it recede in the course of a few weeks; a proceeding strongly advocated by the late Sir A. Cooper, who objects to

Fig. 356.

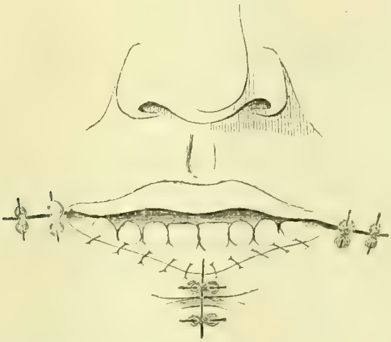


Compressor of Hainsby. A.A.A.A. Skull-piece formed of four bands of steel, to maintain gentle pressure on the head, supported by an elastic chin-strap. B.B. Rigid circle or stem supported on the band of steel. C. the screw which fixes the stem. D.D. pads, articulated on the stem, with free joint, to support the cheeks. E. Headed screw by which the pressure of the pads can be increased. F. Key for the screw. (From Larcher, op. cit.)

cutting away the bony projection. A case is related in which an infant of two months old, suffering from hare-lip and projection of the bone, was subjected to pressure for a period of three months; when the bone had been so effectually depressed by means of a kind of spring-truss, which was worn several hours daily, that the soft parts admitted of being brought over it with tolerable facility. Union followed very well.* Desault applied pressure by means of a band tied tightly behind; and it is said that in one case he accomplished his purpose sufficiently in eighteen days. M. Gensoul seizes the piece with strong forceps, partially breaks and forces it into the perpendicular, and this proceeding has proved successful. This operation has been adopted in St. Bartholomew's Hospital, and also with good result; the preservation of the incisor teeth being an object of considerable importance. If the piece is connected to a perfect septum nasi, it is a good plan sometimes to cut a triangular piece (base downwards) out of the latter before applying a band to press back the projection.

Restoration of the lower lip.—The restoration of a part of the lower lip, which has been lost by accident or disease, is accomplished by a simpler operation than that for the formation of a new nose. The new structures must be taken from the cheeks, which readily afford a sufficient supply of both skin and mucous membrane. Malgaigne observes, that he had described the proceeding in 1834; and that the late M. Bonnet, of Lyons, had put it into practice. Serres, of Montpellier, has given a full

FIG. 357.



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* Cooper's *Dictionary*, p. 594, 1830.

account of it in his interesting work; but the principle dates back as far as Celsus.

Operation.—We suppose the case to be one of cancer affecting the lower lip. All the degenerated parts must be taken away either by a V-shaped incision, according to ancient usage, or by two vertical incisions passing down to the base of the jawbone, and united there by a transverse incision.

In the first instance, there will be the loss of a triangular piece of the lip and chin; the angles of the mouth must then be prolonged by a transverse incision on each side into the cheek, so that two triangular flaps are obtained. The borders of the V-shaped incision are then united by suture; while, as regards the upper border, all that is not wanted for the formation of the new lip, which is formed out of the substance of the cheek, is united to the part with which it is in contact. The mucous membrane in the mouth should be united to the skin by fine sutures.

When the loss of substance is quadrilateral, two other incisions, parallel to the two continued from the commissures of the mouth, must be made along the base of the jaw. Two quadrilateral flaps may then be dissected from the bone, brought forward, and united in the median line by sutures, as in the former operation. This last method, says Malgaigne (from whose work the preceding passages have been taken), is but the proceeding of Celsus, badly understood by his translators; a proof that in order to translate a surgeon, it is not only necessary to know the idiom that he uses, but likewise the science of which he treats.

It follows from this proceeding, that the cheeks alone contribute to form the lip, the free border of which is constituted by the bleeding border of the horizontal incision. Thus, the new lip contains the muscular fibres belonging to the orbicularis and its antagonists; it is covered behind by the natural mucous membrane, and this membrane may be turned over and united to the skin, so as to resemble more closely the natural feature.

The modification of this operation commonly performed in this country corresponds in principle so closely to the above, that further reference is unnecessary.

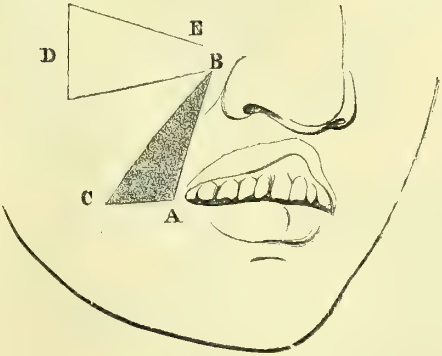
Mr. Syme has introduced an operation by which the cancerous ulcer of the lower lip is first removed by two incisions, extending from the angles of the mouth to the chin, and uniting below, so as to include a piece of triangular shape.

The cuts are then carried obliquely downwards and outwards on each side, under the body of the jaw, and made to terminate in a slight curve outwards and upwards. The flaps thus formed are detached from their subjacent connections, and the whole raised upwards, so that the original triangular incision comes into a horizontal line, and is made to constitute the margin of the new lip; the secondary incisions, under the jaw, coming together in a vertical direction, in which they are retained by twisted and interrupted sutures.*

These operations are preferable to that of Chopart, who made an incision on each side of the tumour, vertically downwards over the lower jaw, according to the magnitude of the operation, even down to a level with the os hyoides. This quadrilateral flap is dissected off the bone, in its entire thickness; the parts morbidly altered are cut away by a transverse incision. The remaining portion of the flap is then raised to the proper level of the mouth, where it is retained by suture; the head at the same time being depressed, to diminish tension.

Restoration of the upper lip.—Plastic operations to restore loss of substance in the upper lip are rarely necessary; one, and perhaps the chief reason being, that cancer is so extremely rare in this situation that few surgeons have ever been here called upon to deal with its effects. With care a considerable

FIG. 358.



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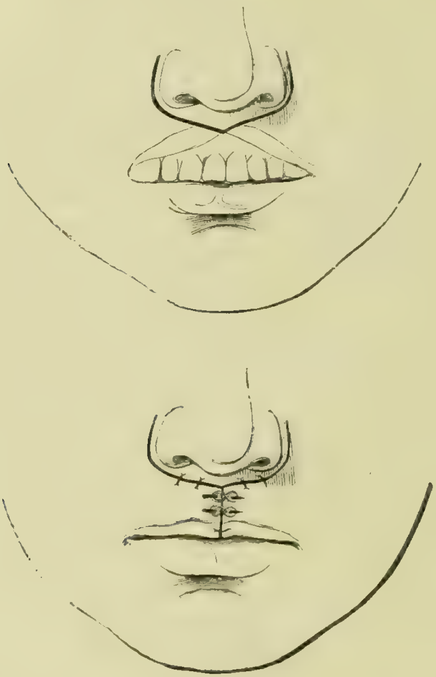
* *Edin. Monthly Journal*, 1847.

amount of integument can be obtained from the cheeks, and united, as in the case of the lower lip, by sutures in the mesial line. The front teeth will thus obtain a covering and be protected from the cold, and the expression of the face will be much improved.

The first operation is that proposed by Von Ammon, who describes a shrinking of the upper lip, sometimes caused by prolonged salivation, by which the part is tightly stretched over the arch of the teeth, and sometimes adherent to the gums. This condition Von Ammon rectifies in the following way.*

FIG. 359.



The lip is first freed by a scalpel from the gum. Then an incision (Fig. 358), A B, is carried upwards from the angle of the mouth, for about an inch and a half, towards the alæ nasi. The tense parts separate, and this longitudinal fissure becomes triangular in form, A B C. A flap of integument is then dissected from the cheek, B D E, and is brought down to fill up the space at the angle of the mouth. After the operation has been com-

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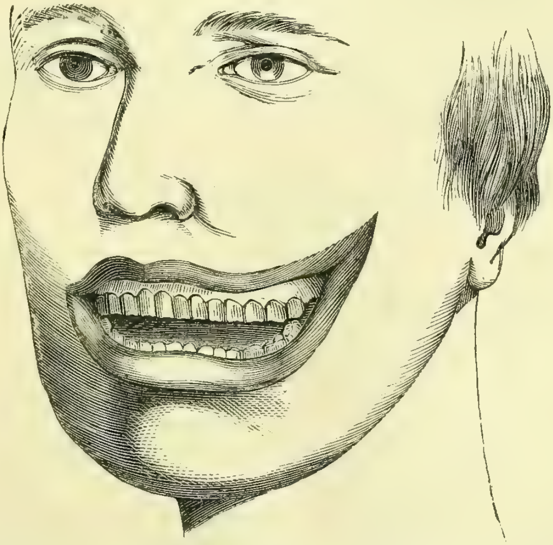
† Ammon und Baumgarten, *Plastische Chirurgie*, p. 155.

pleted on one side of the mouth, it is to be performed on the opposite.

I have no personal experience of this operation. When the central part of the upper lip is destroyed (Fig. 359), the two side portions become drawn up towards the septum and alæ nasi, and the incisor teeth are completely exposed. Dieffenbach rectified this deformity by bringing a sufficient amount of integument from the adjacent substance of the cheeks on either side. He carried an incision by the side of the alæ nasi, down through the red of the lip; he loosened each half, and, bringing them together in the mesial line, united them by hare-lip pins and sutures.

A few cases of congenital extension of the fissure of the mouth into the substance of the cheek have been recorded by Sir W. Fergusson, by Von Ammon and by Langenbeck. In Sir W. Fergusson's case, described under the head of macrostoma, the fissure extended so far backwards as to leave exposed the back teeth. In Von Ammon's case the fissure extended to the angle of the eye. Relief was afforded by operation.

FIG. 360.



Fissure of the lips, after Langenbeck. (From Larcher. Op. cit.)

Plastic Operations on the Ear.

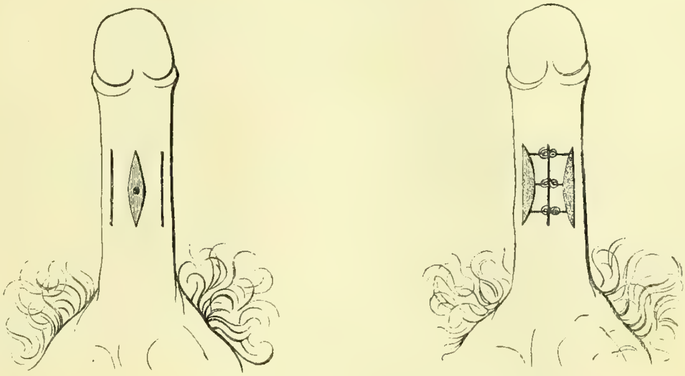
Defects of the external ear attract so little attention, and are in general so easily concealed by the hair, that plastic operations are rarely required. I have removed considerable portions of the pinna for warty and carcinomatous growths, and find that the wound heals best, and with less deformity than might be expected, without sutures or any dressing beside a piece of wet lint. Dieffenbach, however, has replaced a piece of the pinna removed by the stroke of a sword; but he took the flap from the adjacent region of the scalp, a part which surgeons are for the most part slow to touch. Having pared the edge of the ear, he made an incision of parallel length and about the same level through the adjacent scalp; from either end of this incision, two short cuts were extended upwards. After hæmorrhage had ceased, the raw edge of the ear was united by suture to the corresponding edge of the scalp. Oiled lint was inserted underneath. At the expiration of three weeks, union being perfect between ear and scalp, the portion of requisite size was completely detached from the latter situation. It is said that the transplanted portion first became blanched, but soon regained the circulation and normal warmth. I have no personal experience in the proceeding. (See also DISEASES OF THE EAR, vol. iii. p. 257.)

Plastic Operations on the Penis.

Plastic operations on the penis for deformities or imperfections, both acquired and congenital, are, as a rule, unsatisfactory in their results. Nature seems here able to effect a cure unaided by art, whenever the general conditions are favourable to recovery, or when the law of development has not been prematurely arrested. Thus fistulous passages in the urethra depend for the most part on strictures of the canal, which once properly dilated permit the ready cicatrisation of the artificial opening; and congenital deficiencies in the urethral walls usually indicate an imperfect condition of the canal beyond this point, but the tube is perfect so far as it is properly formed.

In the treatment of fistulous passsages, whether near the scrotum or in the proximity of the glans, the careful employment of the catheter is the first measure necessary. The edges of the fistulous opening may after a time, if inactive, be stimulated by such remedies as tinctura cantharidis or nitrate of silver; but in the early stages all such applications are useless. Cases are seen in which, after the operation of lithotomy, a long fistula communicating with the urethra remains in the perinæum. Such a case I have treated successfully with galvano-cautery; i.e. by introducing a piece of wire the length of the fistula, and heating it by attaching it to the circle through which the electrical stream was passing.

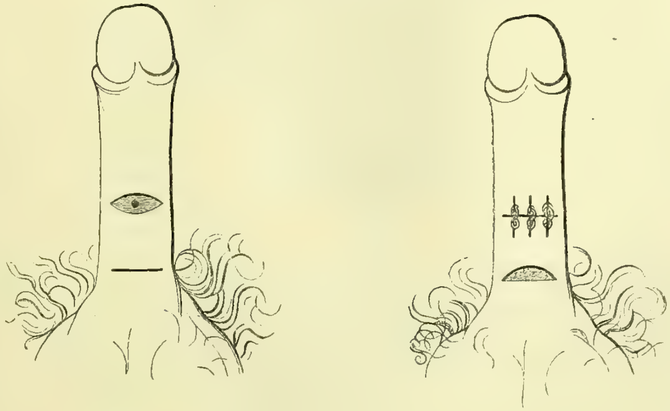
Fig. 361.



The simplest method of closing an opening in the urethra by a plastic operation is as follows:

Operation.—The surgeon must dissect away a lozenge-shaped portion of integument from around the fistulous opening. He then brings the edges of the skin together with sutures; lastly, he makes a longitudinal incision on either side of the newly united wound to relieve tension (Fig. 361). The operation is simple and easily performed, and looks well in a diagram. But

Fig. 362.

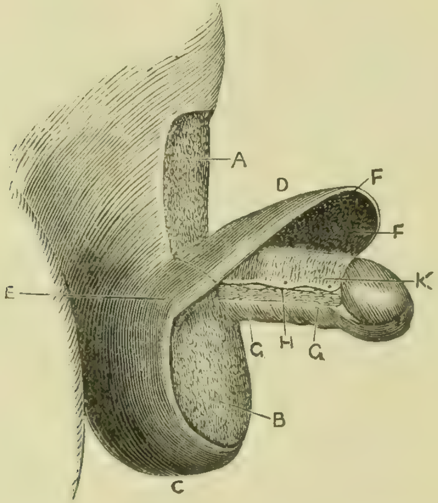


there is difficulty in preventing the urine insinuating itself between the edges of the wound, causing the parts to reopen, or even leading to mortification of the flap.

The same remark applies to a similar operation in which the incision is made transversely, and the flap of integument is drawn from behind (Fig. 362). There is no difficulty in obtaining skin enough, especially towards the root of the penis.

In cases of still greater defect in the walls of the urethra, Dieffenbach has made transverse incisions through the integument before and behind the opening, and brought over it the intervening skin from the upper surface of the organ. But, inasmuch as the operation has not been promising in its results, I must refer the reader to that surgeon's works for matters of detail. The operation of M. Alliot* is perhaps the most ingenious, and has moreover been reported as successful.

FIG. 363.



Nélaton's operation for epispadias (From Larcher's translation of 'Holmes on Surgical Diseases of Children'). A, the part from which the abdominal flap has been taken. B, the part from which the scrotal flap has been taken. C, the lower part of the scrotum. D, the scrotal flap, which has been notched in the middle of its base to allow the penis to be slipped through it. E, the lateral adherent parts of the scrotal flap. F, F, the anterior border and bleeding surface of the scrotal flap. G G, the refreshed edges of the skin of the penis. H, the raw edges of the abdominal flap. K, the bleeding surface of the abdominal flap, on which the bleeding surface of the scrotal flap is to be applied.

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* Fritze, op. cit. p. 116.

He circumscribes and dissects a small quadrilateral flap; and taking away from the other side a portion of skin equal to this flap, he so covers the fistula and the loss of substance, that the principal sutures are at a distance from the urine when it traverses the urethra.

The terms hypospadias and epispadias are given to two congenital anomalies of the male urethra, in which the orifice of the canal is situated more posteriorly than natural. In the first form, which is the more common, the urethra opens generally by a very little orifice on the inferior surface of the penis; in the latter, the opening is on the dorsal surface of the organ. In the cases of epispadias which have been published the orifice of the urethra appears to have been situated very near to the pubis; in some instances the pubic bones have been imperfectly developed, and indeed have been represented by ligaments. An interesting case is recorded by Mr. Partridge (*Trans. Path. Society*, vol. xvi. p. 192). Additional difficulty in the way of treatment by operation proceeds from the fact that the arrest of development generally extends in some degree to the bladder itself.

M. Follin attempts the closure of the open urethra in epispadias, by first making incisions along the upper surface of the penis, at the junction of the skin and mucous membrane, dissecting on either side so as to expose a raw surface, and then bringing down from the front of the abdomen a flap of integument, which is to be accurately fitted in to the open urethra. A covering of integument is next obtained at the expense of the scrotum. I have no experience of the operation. One on a similar principle, performed by M. Nélaton, is represented in Fig. 363.

In the case of hypospadias surgery does not offer any favourable results. Attempts to establish a urethra in the substance of the penis by means of a fine trocar, have usually been followed by violent attacks of inflammation, and by partial gangrene, without the patient obtaining even ultimate benefit. The case is one of arrested development, in which the construction of the parts is irremediable.

On the Treatment of Contracted Cicatrices.

Within the vagina.—The mucous membrane of the vagina is subject in infancy to a low form of inflammation, which terminates in sloughing of part or of the whole of its circumference.

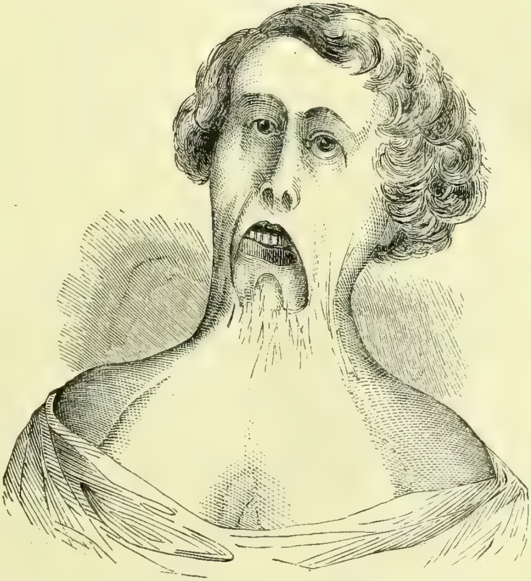
The separation of the slough, and subsequent cicatrisation of the wound, is followed by contraction of the cicatrix, and narrowing of the vagina at a variable distance from the os externum. These later changes often escape observation until the patient attains a marriageable age, when she finds connection impossible, and the attempt extremely painful. The cicatrix, however, yields very readily; and the defect may, in many cases, be overcome immediately by the introduction of the fingers or any dilating instrument, the patient being under the influence of chloroform. But this proceeding is not unattended by danger; for if the cicatrix be rudely torn, a low form of pelvic cellulitis is set up, extending perhaps to the peritonæum, under which the patient sinks.

I cannot dwell too strongly on the dangers of violence in all such cases. No cutting instrument should be used; for the integrity of the walls of the vagina must be preserved, and a fresh cicatrix would, by its secondary contraction, lead only to further difficulties. No laceration by sudden violence is permissible, for inflammatory mischief may ensue therefrom. But sponge tents should be introduced, that the contracted orifice may be slowly, cautiously, and painlessly dilated, without laceration, but with gradual absorption of that peculiar material on which the firm dense part of an old cicatrix depends.

Cicatrices from burns, escharotics, &c.—The application of heat or of powerful escharotics will either disorganise the superficial layers of the skin, or destroy its entire thickness. In the former case, cicatrisation is completed without deformity; in the latter, a secondary process, that of contraction, goes on after the new material is formed over the wound; and this contraction proceeds slowly, almost imperceptibly, and painlessly, but irresistibly save by mechanical treatment, until changes as regards the limbs most serious, and as regards the face most hideous, are produced. The smooth white cicatrix drags by its contraction on the surrounding integument, pulling it into folds, and puckering it up as towards a centre. It becomes itself elevated into knobs or tubercles, which seem to grow thicker and thicker the more complete the contraction. There is no limit as to time when the patient can be pronounced free from further extension of the evil, especially among the young during the important period of growth. No tissue is exempt from its influence, and even the bones undergo an alteration in form. In cases of severe burns about the neck, the chin is drawn down, the alveolar border of the jaw and the front teeth are everted, the nose is dragged to one side, the lower eyelid turned outwards, and, when the burn has affected one side more than the other, the whole bony frame-work of the corresponding side of the face has exhibited the marks of the contracting force.

Surgical ingenuity has been pushed to the uttermost to devise operations by which this distressing calamity may be removed; but I express the opinion of most surgeons of experience of the present day, in affirming that hitherto almost all such operations have proved failures; and for this simple reason,

FIG. 364.



that whenever an incision is made, a new cicatrix must be formed, and this new cicatrix will undergo precisely the same process of contraction as the former, which it was intended to alleviate.

It may be laid down as a rule almost without exception, *that a cicatrix should rarely be touched with the knife.*

The late Mr. Earle proposed to cut away the whole of the cicatrix, and then bring the edges of the healthy skin as much towards each other as possible, in the transverse direction, with strips of adhesive plaster. But in most cases this measure is impracticable, either from the situation of the burn, or from the amount of integument already destroyed. Who, for instance, could dissect away a large cicatrix from the front of the neck, and drag forward the skin from the sides and nape by means of strips of adhesive plaster passing over the larynx and trachea? The practice of detaching and transplanting a flap of integument has been recently revived by Mr. Teale of Leeds. But to this proceeding I would quote the words of Mr. Skey: 'There is no difficulty in obtaining sound skin by autoplasm to supply the deficiency and to fill up the space caused by the division of the bridles; but the real difficulty consists in effecting its junction with the diseased parts, and in retaining its vitality, for the base of the wound so made is not to be deemed healthy, but, on the contrary, is greatly indisposed to co-operate with the skin laid down and to accept its union. It would appear that the vital force of this structure is too much exhausted in the struggle against the necessary agents of extension to participate in the healthy actions requisite for adhesion to the structure brought into apposition with it; and when we consider the adventitious nature of this tissue, and the probable condition of its vessels, the failure of these operations is not surprising; but this failure is by no means necessary or universal.'* Mr. Skey has proposed to obtain extension of the cicatrix by means of a number of minute divisions both of the skin and subjacent tissue, founding his practice on what may be deemed, he says, an axiom in surgery, viz. *that the contraction of wounds is slight in proportion as the time consumed in the healing process is short.*† But even in this practice the secondary contraction inseparably connected with a newly-formed cicatrix cannot be avoided; and I therefore would direct especial attention to the method of treating these cases by mechanical extension alone.

When gentle yet constant traction is exerted on a hard and contracted cicatrix, it yields, without tearing, with singular facility; the hard knots disappear, the firm seams become soft and pliant, and the new skin regains the suppleness, though not the completeness, of the natural structure. After extension has been kept up a sufficient length of time, the material on which the contracting power depends becomes absorbed, and the elongation of the cicatrix is permanent.

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* *Operative Surgery*, p. 687.

† Op. cit. p. 688.

The results of this treatment are mostly satisfactory, and failure proceeds from want of patience, which substitutes forcible, and as it were spasmodic, efforts, for persevering and unremitting gentleness.

To the objection that the system is tedious, I would reply, what can be more wearisome than the attempt to heal a large open sore following a divided cicatrix? The principle in all apparatus for such cases consists in slow extension, effected usually by means of the cogwheel. For the extension of a cicatrix in the neck we employ a pelvic band of steel, with two side crutches and a webbing-band in front to keep the instrument steady; a posterior steel upright, to which is attached a headpiece with branches, movable in every direction by means of cogwheels and a strap passing under the chin.* Every day, or every other day, the smallect possible amount of extension must be made and maintained; but the patient should suffer no pain, nor must the skin be allowed to break. If a sore should form, the apparatus requires removal, and the advantages thus far obtained will be lost during the tedious cicatrisation.

The same remarks apply to the extension of the cicatrix of a contracted limb. The apparatus, modified according to circumstances, must be worked by a cogwheel, which insures steady, unremitting, and yet limited exercise of force. The hardened seams elongate and become soft, and the freedom of movement is regained far more speedily, effectually, and painlessly, than by any other means.

In slighter cases a great amount of benefit will ensue from direct pressure; a piece of vulcanised India-rubber is moulded exactly to the contracted part, and is retained there by a bandage, strap, or elastic roller. In the course of a few weeks the hardened seams become softer, and the integument regains its lost pliancy. This practice is useful in cases of contraction of the elbow in children; also in the treatment of contractions of the neck, especially in combination with the extending apparatus, when the chin seems lost in the deformity, and the teeth are assuming a horizontal direction.

Transplantation of skin.—All surgeons are familiar with the cases of large open chronic ulcers on the lower extremities of the working classes; with the extensive granulating surfaces which are the consequence of burns; with the vast denuded wounds, which follow machinery accidents. This loss of skin constitutes the most important feature of the case, for it seems to paralyse all efforts at repair, and in many cases amputation or other operations have been undertaken, upon the conviction that no reasonable hope could be entertained of the accomplishment of cicatrisation.

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* For details as to these instruments, see the Appendix: SURGICAL APPARATUS.

In the early part of 1870, a paragraph appeared in the daily papers, containing some severe remarks on an operation for transplanting skin upon open wounds as performed by a 'Hospital Surgeon,' who proved to be Mr. Pollock of St. George's. The ingenuity and merit of the invention, which is due to M. Reverdin of Paris, the readiness of adoption, which is due to Mr. Pollock, and the great success which has followed the numerous trials and experiments now made in every direction, warrant the conclusion that the proceeding is one of the most striking and successful in modern surgery. The proceeding is simple: several minute pieces of skin, about the size of a millet-seed, and in number according to the size of the open sore, are taken from the thigh or from some other convenient part of the same individual; they are then carefully introduced under the granulations and maintained there by plaster. In the course of a few days each point of detached and transplanted skin becomes the centre of cicatrisation, which spread one towards the other, or towards the circumference of the sore. First was noticed a slight bluish ring, which, in a few hours acquired in every instance the character of a thin cicatrix So simple and so beneficial was this operation found, that in St. Bartholomew's, and I hear also in other Hospitals, the house-surgeons have adopted it as a common method of treatment. Mr. Young, of St. Bartholomew's Hospital, has favoured me with the following case.

William T., aged sixty-one, was admitted October 27, 1870, with a large chronic ulcer of the left leg, nearly surrounding the limb, and of twenty-five years' duration. There was a smaller ulcer of the right leg of two years' duration. On November 4 Mr. Young planted four pieces of skin from the thigh on the ulcer, simply laying them on the granulations and covering each of them first with a small piece of oiled lint. The whole ulcer was then covered with lint soaked in zinc lotion; it was supported by a roller. On November 20, seven additional pieces were planted. On November 30, three more pieces were planted; December 3, one larger piece was planted in the centre of the same leg.

December 16. The present condition of the limb is as follows: Most of the transplanted pieces have become adherent. Those planted six weeks ago have spread to the size of a florin piece. Those planted on November 20 are now about the size of a shilling. Lastly those of a fortnight's duration are about the size of a threepenny-piece. But besides this, the whole ulcer, which had been for so many years and under all circumstances stationary, has become contracted to about half its original size. One piece of transplanted skin situated near the edge of the ulcer was noticed to spread until the two finally coalesced. The case terminated most satisfactorily.

It was observed, with reference to the larger portion of transplanted skin, that a natural effort was required for the maintenance of its vitality; the cuticle separated, some of the deeper structures seemed to slough, and its adhesion to the granulating surface was incomplete and often unsatisfactory. Indeed, it seemed as if the smaller the piece of transplanted skin, the more satisfactory was the process; and thus the inference was drawn, that if a bit of skin were cut off and chopped into minute bits on the thumb-nail, and these pieces were strewed broadcast over the ulcer, union would take place as usual with less trouble and with a more rapid result.

The following case is also instructive. Charles G., aged forty, had a large chronic ulcer commencing about two inches above the malleoli on the front and internal surface of the leg, and extending nearly six inches upwards, with an average width of three to four inches, well defined and somewhat irregular. The whole of two to three years' duration. He was admitted October 12, 1870. October 22, four pieces of skin about the size of a grain of wheat, taken from the thigh, were transplanted by myself, the whole limb being afterwards covered by wet lint and a bandage. October 28 the lint was removed; three of the pieces were adherent, and there was an increase of vascularity in the granulations surrounding the transplantion. The case ended well; the wound being completely closed.

Mr. Cumberbatch performed the following experiment. On Saturday, December 17, 1870, an arm was amputated at St. Bartholomew's Hospital at 2 P.M.; at 6 P.M. Mr. Cumberbatch entered the theatre, four hours after the operation, and took from the limb, which was then quite cold, a portion of integument. He cut it up into small pieces, which he transplanted in the usual way. After bandaging the part he opened the wound on the fourth day, and found that union had taken place, and that cicatrisation was going on favourably from the various points; the case terminated favourably.

In the *Gazette médicale de Paris*, 1870, there is a proposal from M. Marc Sée to substitute for the above method simple epidermic transplantation. Sufficient time has not yet elapsed to allow a definite opinion to be formed from the experiments now being conducted in reference to this point.*

HOLMES COOTE.

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* The proposal to substitute the lining membrane of a fresh egg in place of the living tissue has not merited further remark, except that it differs in no respect from covering an open wound with goldbeaters' skin.

AMPUTATION.

AMPUTATION is often regarded as an opprobrium of the healing art. But while the human frame remains liable to derangement from accident or disease, the removal of hopelessly disordered parts, in the way most conducive to the safety and future comfort of the sufferer, must ever claim the best attention of the surgeon. Indeed, the progress of medical science, while furnishing the means of curing some affections once regarded as hopeless, and thus in one sense restricting the field for the application of amputation, has in another point of view extended that field, by improving the mode of operative procedure, and divesting it of much of its terror and danger; so that whereas in former times the removal of a limb was only resorted to in cases of the most serious nature, it is now often practised when the offending member is merely a source of inconvenience.

It is instructive to trace the history of the improvement of this department of surgery.

Hippocrates (B.C. 430) recommended only a very rude kind of amputation, consisting of cutting through mortified limbs at some joint, 'care being taken not to wound any living parts.'*

On the other hand, Celsus, who seems to have lived at the commencement of the Christian era, advised that the removal of gangrenous limbs should be effected between the dead and living parts, and so as rather to take away some of the healthy textures than leave any that were diseased; and as he interdicted amputating through an articulation, his operations must often have been performed entirely through sound tissues. He directed that the soft parts should be divided with a knife down to the bone, and then dissected up from it for some distance, so as to allow the saw to be applied at a higher level. The rough surface of the sawn bone was then to be smoothed off, and the soft parts, which, as he tells us, will be lax if this plan be pursued, were to be brought down so as to cover the end of the bone as much as possible. This method seems calculated to afford good results; particularly as it appears probable from his writings that Celsus employed the ligature for arresting hæmorrhage after amputation,* and dressed the stump in a manner favourable to the occurrence of primary union.

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* *Hippocrates de Articulis*, p. 639 of the Sydenham Society's translation.

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* On this interesting point in surgical history I am disposed to agree with the author of the article 'Amputation' in Rees's *Cyclopædia,* in opposition to the prevalent opinion that Celsus employed the ligature only in ordinary wounds, and used the actual cautery in amputations. The directions of Celsus regarding amputation are contained in his chapter on the treatment of gangrene, in which the only mention of hæmorrhage is the statement that patients often die of it during the performance of the operation *(in ipso opere)*, referring doubtless to profuse bleeding resulting from ignorance of the circulation of the blood, and of any means of controlling it in the limb. Certainly this expression is no proof that the cautery was used rather than the ligature; for the former is the more speedy method of the two. Neither is the absence of allusion to the ligature in this passage any evidence against its employment after amputation; for the argument would apply equally to the cautery, and no one doubts that one of these two means was used. Celsus, who is remarkable for his extremely concise style, leaves us to refer to his previous chapter on wounds, in which the subject of hæmorrhage is very ably discussed. In slight cases pressure with dry lint, and a sponge wrung out of cold water, is recommended, or if this does not answer, lint steeped in vinegar is to be used; but any portion of dressing retained in the wound is said to do mischief by causing inflammation; and on the same principle caustics and other powerful styptics, though very efficient in arresting the bleeding, are prohibited because they produce a crust, which acts like a foreign body. In more severe cases the vessels are to be tied; and finally, 'when the circumstances do not even admit of this,' the red-hot iron may be used as a last resort.

The only thing that seems to me to give any colour for doubt upon this subject, is the manner in which the ligature is described, 'venæ quæ sanguinem fundunt apprehendendæ, circaque id quod ictum est duobus locis deligandæ intercidendæque sunt;' language which seems rather to apply to a partially divided artery than to one completely severed; but as the context shows that the ligature, as used by Celsus, was applicable in the majority of cases, and to more vessels than one in the same wound, it can hardly be conceived possible that the practice was restricted to the very rare case of partial division.

Again, there can be little doubt that in drawing down the soft parts over the bone after amputation, Celsus aimed at primary union, the great advantages of which are strongly insisted on in the same admirable chapter on wounds; but it is certain that he knew that the use of the cautery would have destroyed any chance of union by first intention.

One argument that has been urged on the other side is, that if he had

Archigenes, who practised in Rome shortly after the time of Celsus, paid special attention to the control of hæmorrhage during the performance of the operation; and appears to have been the first to employ for this purpose a tight band or fillet encircling the limb above the site of amputation. But while in this he did good service, he applied the red-hot iron to the surface of the stump, and also neglected the dissection of the soft parts from the bone, advised by Celsus, though compensating to a certain extent for this omission by retracting the integuments before dividing them.*

Galen, who was in truth more of a physician than a surgeon, declined still more from the Celsian precepts, and, reverting to the practice of Hippocrates, advised amputating through the dead tissues, and applying the cautery to the residue of the mortified part; † and for several centuries after his time either this method or others equally rude and often much more barbarous continued to be employed.

During the middle ages, the ligature, though used for ordinary wounds, was never thought of in amputation; and whatever may have been the practice of Celsus in this respect, there is no doubt that the great French surgeon Ambroise Paré, when he so applied it, in the middle of the sixteenth century, had all the merit of originality. But though he urged its superiority over the cautery with able argument, supported by his extensive experience in both military and civil practice, yet his teaching failed for a long time to influence surgeons generally, either in his own country or in other parts of Europe.

The principal reason for this appears to have been that the fillet, which was the means still in use for controlling the bleeding during the operation, did not answer its purpose effectually even in the ablest hands; so that the dread of hæmorrhage led most surgeons to prefer the cautery as a more expeditious method than the ligature. We even find Fabricius of Aquapen-

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employed the ligature in amputation, it would hardly have been neglected by his successors: but the slowness of the surgeons of the sixteenth and seventeenth centuries to adopt it, in spite of the strenuous advocacy of Paré, with all the advantages of a printed literature, show how little weight is to be attached to this objection. The utter neglect, during the middle ages, of the Celsian method of amputation, and of his simple mode of treating wounds, may also be mentioned as analogous cases.

* Sprengel's *History of Medicine*, French translation, vol. ii. p. 81, and vol. vii. p. 312.

† *Galeni ad Glauconem*, lib. ii. cap. xi.

dente repeating, in 1618, Galen's timid doctrine of the danger of amputating through living parts at all;* and in 1633 the celebrated Fabricius Hildanus, though describing the ligature, states that the time which it occupies, and the consequent loss of blood, make it suitable only for the robust and plethoric, and declares that he 'cannot sufficiently extol the excellence' of the *cauterium cultellare*, or red-hot knife, by which the orifices of the vessels were sealed while they were divided.†

In consequence of this same fear of bleeding, the great object at this period seems to have been to accomplish the work of severance of the limb as speedily as possible, and this was often done without any attempt whatever to provide a covering for the bone. Scultetus, in 1655, depicted the performance of amputation of the hand by chisel and mallet; and Purmannus, in his *Chirurgia Curiosa*, written as late as 1696, mentions having seen legs removed by two different surgeons by modifications of a barbarous instrument of the middle ages, a sort of guillotine, 'which, by its great weight and sharpness, cuts at once the skin, flesh, and bones asunder;' but he states that it splintered the bone, and *therefore*, 'all things considered, the ancient way of cutting through the flesh with a knife, and through the bone with a saw, is more practicable, safe, and certain.'‡

As an example of the ordinary practice of the seventeenth century, may be mentioned that of Richard Wiseman, Sergeant-Surgeon to King Charles II. A fillet having been tightly applied, for the three-fold purpose of checking hæmorrhage, rendering the limb less sensitive by pressure on the nerves, and steadying the soft parts, which were retracted by an assistant, he carried a crooked knife by a single circular sweep down to the bone, which was divided with the saw at the same level, and the bleeding was arrested by the cautery, or some kind of styptic.§

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* *Hieronymi Fabricii ab Aquapendente Opera Chirurgica*, pars i. cap. xcvi.

† 'Porro excellentiam hujus cauterii non satis extollere possum.' *Gul. Fabricii Hildani Opera omnia*, lib. de Gangrænâ et Sphacelo.

‡ Purmannus' *Chirurgia Curiosa*, English transl. book iii. chap. xii.

§ The ligature, though known to Wiseman, seems not to have been adopted by him. After describing different modes of applying it, in a way that shows pretty clearly that he had not practised them, he writes, 'But the late discovery of the royal styptic hath rendered them of less use. But in the heat of fight it will be necessary to have your actual cautery always ready, for that will secure the bleeding arteries in a moment, and fortify the part against the future putrefaction.'—*Chirurgical Treatises*, book vi.

Thus the mode of amputation employed by the father of British surgery not two centuries ago, was precisely that used fifteen hundred years before by the Roman Archigenes. And very unsatisfactory were the results which it commonly afforded. The soft parts were insufficient, even in the first instance, to cover the end of the bone, which was accordingly cauterised, with the object of accelerating its inevitable exfoliation, and in the further progress of the case it tended to become more and more exposed by the contraction of the muscles; and even if the patient survived the protracted suppuration that ensued, he suffered more or less from the inconveniences of what has been called the sugar-loaf stump, being in the shape of a cone, the apex of which was formed by the prominent bone, covered either by a sore which refused to heal, or by a thin pellicle of cicatrix, very liable to abrasion.

A great step towards a better order of things was made in 1674 by the French Surgeon Morel, in the invention of the tourniquet,* which, though at first but a rude contrivance, being a stick passed beneath the fillet and turned round so as to twist it up to the requisite degree of tightness, furnished the basis for the greatly improved instrument devised in the early part of the following century by his distinguished countryman J. L. Petit. This consisted essentially of two metallic plates, which could be separated from one another by means of a screw, so as to tighten a strap which was connected with them and also encircled the limb; and it is upon this principle that the ordinary screw tourniquet is still constructed. From this time forward, except in amputations performed near the trunk, hæmorrhage during the operation ceased to be an object of dread, and surgeons were at liberty to consider other questions besides mere rapidity of execution.

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* English surgeons might dispute with the French the honour of the invention of the tourniquet. In a work written in 1678, published in 1679, entitled *Currus Triumphalis e Terebintho*, Mr. James Young of Plymouth gives an account of a similar contrivance, apparently produced independently by himself. He describes it as 'a wadd of hard linen cloth, or the like, inside the thigh, a little below the inguen; then, passing a towel round the member, knit the ends of it together, and with a battoon or bedstaff, or the like, twist it till it compress the wadd or boulster so very straight on the crural vessels that (the circulation being stopped in them) their bleeding, when divided by the incision, shall be scarce large enough to let him see where to apply his restrictives' (p. 30). Further on in the book he states that the same principle is applicable with advantage in amputations of the upper limb. But as he does not inform us how long he had used this expedient before he wrote the account of it, the credit of priority must of course be accorded to Morel.

The improver of the tourniquet, and our own great countryman Cheselden, seem to have conceived independently of each other the idea of performing amputation by 'double incision;' in which the skin and fat were first cut through by a circular sweep of the knife and retracted for about an inch, when the muscles and bone were divided as high as they were exposed.*

But this, though a great improvement, had only the effect of diminishing the cicatrix without covering the bone;† and Louis, another eminent Parisian surgeon, believed that in the thigh the objects sought might be better attained by dividing all the soft parts at once, and sawing the bone at a higher level. In order to allow the muscles to contract freely when divided, he avoided the use of the tourniquet, and was the first to employ in its place digital compression of the femoral artery at the groin. He pointed out the important circumstance that the muscles on the posterior aspect of the thigh being divided far from their origin at the pelvis, contract to a much greater extent than those at the anterior part of the limb, which are connected with the bone where they are cut; and he showed that, the soft parts having been severed to the bone by a circular incision and drawn up with a linen retractor, the saw might be readily applied two-and-a-half inches higher up, after the knife had been carried through the attachments of the anterior muscles.‡ This method was amputation by double incision on a different principle; and though, in truth, a revival of the practice of Celsus, was not less valuable than the plan of Cheselden and Petit, and seems to have afforded results superior to theirs.*

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* It is difficult to determine to whom the priority belongs in this matter. Petit in his posthumous work states, 'Je suis le premier qui ait coupé les chairs en deux temps;' and also, 'J'ai imaginé de couper les chairs en deux temps;' and Dieffenbach, in his *Operative Surgery*, gives 1718 as the date of the introduction of the double incision by Petit. On the other hand, Cheselden as distinctly claims the original idea in the following passage in his notes to Gataker's translation of *Le Dran's Surgery*: 'The thing that led me to do this was what has too often happened—the necessity of cutting off the end of the stump the second time. This operation I proposed to my master when I was his apprentice; but he treated it with neglect, though he lived afterwards to practise it when he had seen me perform it in the same hospital.' This proposal must have been made before 1711, when, at the age of twenty-two, he began to lecture on anatomy.

† This is well illustrated by the drawing of a stump given by Cheselden in *Le Dran's Surgery*, for the purpose of showing the good effects of the double incision.

‡ *Mémoires de l'Académie de Chirurgie*, vol. ii. p. 286.

Louis, however, was content if the stump when healed was free from conical projection,† and did not aim at forming a complete covering for the bone. This was effectually done about a quarter of a century later by Alanson of Liverpool, by dissecting up the integuments for some distance and then dividing the muscles obliquely, so that they formed a hollow cone, in the apex of which the bone was sawn 'about three or four fingers' breadth higher than was usully done.' The effect of this was to 'fully cover the whole surface of the wound with the most perfect ease;'‡ but in the hands of other surgeons the oblique division of the muscles proved to be a matter of considerable difficulty, and the object was accomplished as efficiently and more simply by Mr. Benjamin Bell of Edinburgh,§ and Mr. Hey of Leeds, by a combination of the methods of Cheselden and Louis; or, as Mr. Hey expressed it, 'with a triple incision,'‖ in which the skin and fat were first divided circularly and dissected up for some distance, then the muscles were cut at a higher level, and these were retracted so as to permit the bone to be exposed and sawn considerably higher. Mr. Hey added the advice to cut the posterior muscles somewhat longer than the anterior, to compensate for their greater contraction; and thus, towards the end of last century, 'the circular operation,' as it is termed, may be said to have been brought to perfection.

Meanwhile a different principle had been long before suggested and acted on. So early as 1678, Mr. James Young of Plymouth described 'a way of amputating large members, so as to be able to cure them *per symphysin* in three weeks, and without fouling and scaling the bone.' The directions given for this method, the 'first hints' of which he says he had 'from a very ingenious brother of ours, Mr. C. Lowdham of Exeter,' are as follow: 'You are with the catling, or some long incision-knife, to raise (suppose it the leg) a flap of the membranous flesh covering the muscles of the calf, beginning below the place where you intend to make excision, and raising it thitherward of length enough to cover the stump; having so done, turn it back under the hand of him that gripes; and as soon as you have severed the member, bring this flap of cutaneous flesh over the stump, and fasten it to the edges thereof by four or five strong stitches.'* Eighteen years later, Verduin, a surgeon of Amsterdam, ignorant apparently of what Lowdham had done, provided like him a covering for the end of the stump from the calf; but instead of cutting from below upwards, and only raising the integuments, he thrust a knife behind the bones at the part where he intended to divide them, and cutting downwards formed a muscular flap, which he afterwards supported by an apparatus devised for the purpose of pressing the cut surfaces together so as to check bleeding without the use of either cautery or ligature.† This machine being complicated and unsatisfactory, was rejected in 1750 by M. Garangeot,‡ who, substituting the ligature for it, but retaining in other respects the method of Verduin, brought amputation of the leg to the form in which it is still often practised at the present day.

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* *Mémoires de l'Académie de Chirurgie*, vol. iv. p. 60.

† 'L'amputation la plus parfaite est, sans contredit, celle dans laquelle les chairs qui forment l'extrémité du moignon conservent assez de longueur pour se maintenir au niveau du bout de l'os.' Op. cit. vol. iv. p. 41.

‡ Alanson's *Practical Observations on Amputation*, 2d edit. p. 16.

§ Benjamin Bell's *System of Surgery*, 7th edit. vol. vii. p. 260.

‖ Hey's *Practical Observations*, 3d edit. p. 527.

The same principle was applied to the thigh, in 1739, by Ravaton, of Landau; but instead of one long flap he made two short ones. Having divided all the soft parts circularly, he thrust a knife down to the bone on the anterior aspect of the limb, a hand's-breadth higher up, and cut down to the circular wound; and, having made a similar longitudinal incision behind, dissected up the square lateral flaps thus formed, and sawed the bone where it was exposed at their angle of union, and brought them together after tying the vessels.§

Vermale, surgeon to the Elector Palatine, soon afterwards formed the flaps more easily, and of a shape better adapted for union, by introducing a knife at the front of the limb and pushing it round the bone at one side, so as to make it emerge at the opposite point behind, and then cutting a flap of rounded form by carrying the knife in a curved manner downwards and outwards, the same process being repeated on the other side.*

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* James Young's *Currus Triumphalis e Terebintho*, p. 108. A copy of this interesting book exists in the library of the Royal Medical and Chirurgical Society of London.

† *Mémoires de l'Académie de Chirurgie*, vol. ii. p. 244.

‡ Ibid. p. 261.

§ Ravaton's *Traité d'Armes à feu*, p. 405; also *Mémoires de l'Académie*, vol. ii. p. 251.

The flap operation, performed either by cutting from without inwards or by transfixion, was occasionally employed by various surgeons in the latter half of last century; but found its most strenuous advocate in the late Mr. Liston, and at one time seemed likely to supersede the circular method altogether. Its great merit in those days of painful surgery was its facility and speed ; for the flaps were cut with great rapidity, and when they were drawn up by the assistant, the bone was exposed with the utmost readiness at the part where it was desirable to divide it ; whereas, in the circular operation, to dissect up the ring of integuments was a somewhat troublesome and tedious process, especially in a limb increasing in thickness upwards like the thigh, and the use of a retractor was often necessary, in order that the saw might be applied at a sufficiently high level.

As regards the immediate results of the two methods, the principal difference between them was, that the flaps, when formed by transfixion, contained a large amount of muscle, while the circular mode furnished a covering chiefly from the integument. In this respect the flap operation was at first supposed to have a great advantage, as providing a muscular cushion for the end of the stump. But this opinion was shaken by further experience. The muscular part of the covering, no longer discharging its normal physiological function, degenerates and dwindles, while the integument tends to become thicker and firmer, so that the ultimate results of the flap and circular operations present no material difference. On the other hand, at the time of the performance of the operation, the method by transfixion has the great disadvantage that the muscular element in the flap is almost always redundant, and has to be tucked back to permit the edges of the skin to be stitched together, the natural result being tension and confinement of discharges and consequent inflammatory disturbance. In the very case in which the flap operation was first employed, viz. in the upper part of the leg, the muscular mass proved very inconvenient from its redundancy when the calf was largely developed; and even under more favourable circumstances the heavy and contractile flap was apt to shift from its position or to drag down the skin of the front of the leg, so as to stretch it on the cut end of the tibia, and induce ulceration. Hence Mr. Liston himself, so early as 1839, preferred in muscular subjects a short posterior flap and an anterior one of the same length, composed of integument only;[*] and in the latter period of his practice he changed this for the following modification of the circular operation, which was also suggested independently by Mr. Syme, and was used by him for many years in all cases of amputation in this situation. The skin and fat are divided by two crescentic incisions with the convexity downwards, so as to form short antero-posterior flaps of the integument, which is then dissected up considerably higher than their angle of union, after which the operation is completed as in the ordinary circular method.[†] This plan gives essentially the same result as the circular mode, while the raising of the integument is facilitated, and its edges can be accurately adapted to each other without any of the puckering that occurred at the angles of the wound after the old operation; and experience shows that when the soft parts have been divided in this way they are quite as favourably disposed for primary union as when cut more smoothly in the form of flaps.

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* *Le Dran's Surgery,* Gataker's translation, p. 431.

In the lower part of the thigh, also, the presence of the contractile element in the flaps was found to be injurious by increasing the disposition to protrusion of the bone, from the action of the powerful ham-string muscles, cut so far from their origin at the pelvis. Mr. Syme accordingly adapted his modification of the circular method to that situation;[‡] and I can testify to the sufficiency of the covering which it afforded.

The longer time required for this operation than that by flap was rendered a matter of no moment by the discovery of anæsthesia in surgery, in the year 1846.[§] Independently of the relief from bodily and mental suffering procured by this great event, it must be regarded as an era in the history of amputation, of at least equal importance with the invention of the tourniquet; because, pain being abolished during the operation, as well as dangerous hæmorrhage, surgeons are now, in the great majority of cases, deprived of all excuse for sacrificing any thing, either in plan or execution, to mere rapidity of performance, and are enabled to regard simply what will most promote the two great ultimate objects in amputation—safety to life, and usefulness of the stump.

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[*] Liston's *Elements of Surgery*, 2nd edit. p. 786.

[†] Syme's *Principles of Surgery*, 5th edit. p. 168.

[‡] Ibid. p. 170.

[§] See the Essay on ANÆSTHETICS in this work.

With regard to the latter object, it was till lately an understood thing that the end of the stump was not adapted for bearing any part of the weight of the body. Being tender from the presence of the cicatrix, it was not allowed by the instrument makers to touch the artificial limb at all; the apparatus being applied partly to the sides of the stump, but chiefly to some bony prominence resting on the upper edge of the socket—the tuberosity of the ischium when the thigh is concerned, and in the leg the internal tuberosity of the tibia, the head of the fibula, and especially the lower border of the patella.

To this general rule, however, a striking exception was presented by the amputation at the ankle devised by Mr. Syme, in which the bones are divided just above the malleoli, where they present a broad surface for diffusing the pressure over the integument of the heel turned up to cover them, specially fitted by the character of its epidermic investment and subcutaneous fibro-adipose cushion for bearing the weight of the body, while the cicatrix lies well forward out of reach of pressure. The result is that the patient can stand on the end of the stump as on the natural sole; and when the deficient spring of the arch of the foot is compensated by some elastic material contained in a very simple boot, the limb proves nearly as useful as in its normal condition.

Subsequent experience has shown that similar advantages may be attained to a greater or less degree in stumps formed by amputation higher up the limb. It is easy by proper management to ensure the cicatrix falling out of reach of compression by the end of the bone; and the integument, though tender in the first instance, gradually acquires a brawny and callous character when subjected to regulated pressure, like the skin over the dorsal aspect of the cuboid bone in talipes varus, and thus becomes able to bear the whole or part of the weight of the body according to the breadth of the cut surface of the bone, and the consequent diffusion of the pressure. Indeed, stumps possessing these qualities were occasionally obtained as long ago as the time of Alanson, who, speaking of the condition of a patient on whom he had performed amputation above the ankle by posterior flap, says: 'He has been several voyages to sea, and done his business with great activity. He bears the pressure of the machine totally upon the end of the stump, and has not been troubled with the least excoriation or soreness.'* But it is easy to understand why such results were altogether exceptional so long as the covering for the ends of the bones was provided by a posterior flap, which, from the force of gravity and the preponderating power of the posterior muscles over those at the anterior aspect of the limb, must always tend to drop from its original position, and leave some part of the bone to be covered only by cicatrix. And independently of this, in the case of the leg, the tibia being covered in front merely by the skin, a scar placed anteriorly is much more likely to suffer from pressure against the bone than one situated posteriorly. The amputation at the ankle is, indeed, by posterior flap; but the full rounded cushion formed by the cup-shaped integument of the heel renders this an entirely exceptional case. It is plain, therefore, that with reference to fitness of the stump for bearing the weight of the body, preference should be given to an anterior flap, which moreover has the great advantage of allowing a dependent opening for the escape of discharge.

The recognition of the advantages of the anterior flap is due to the labours of two English surgeons, the late Mr. Teale of Leeds and Mr. Carden of Worcester, working independently of each other, and proceeding by different methods. Mr. Teale, who had the priority in publication, formed a long anterior and short posterior flap in the following manner. Having ascertained by measurement the semi-circumference of the limb where the bone was to be divided, he first traced with pen and ink upon the skin four lines of that length; two longitudinal, extending downwards along the sides of the limb, and two transverse, of which one joined in front the lower ends of the longitudinal lines, while the other ran across behind from one longitudinal line to the other at the distance of a quarter of their length from their upper extremities. Two rectangular flaps of very unequal lengths being thus mapped out, he raised them, including the muscles as well as the integuments, by cutting from without inwards, and sawed the bone at their angle of union; then, after tying the vessels, he bent the long anterior flap upon itself, that it might 'form a kind of pouch for the end of the bone,' turning up its lower edge to meet that of the short posterior flap, to which it was carefully adjusted and united by a few points of suture, some stitches being also introduced where the edges of the skin met at the sides of the stump.*

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* Alanson *On Amputation*, p. 133.

Experience with this method has shown that in properly selected cases it gives admirable results; the patient being often able to rest his entire weight upon the end of the stump; and even where this is not fully the case, the distribution of the pressure between the end of the stump and the bony prominences which formerly alone sustained it greatly increases the comfort and steadiness of locomotion.

Nevertheless it must be admitted that Mr. Teale's operation has serious drawbacks. Precise accuracy of execution being essential to its success, it demands a degree of time and pains which, under ordinary circumstances, would certainly not be grudged, if really necessary, but which most surgeons would be glad to be saved, and which sometimes, as in the pressure of military practice, could not well be given. Again the cut surface is more extensive than with ordinary modes of amputation, involving a larger number of vessels to secure, and also, under some conditions of healing, a more profuse suppuration. But the greatest objection to this method with a view to its general application is the high division of the bone which would frequently be required in order to form the long anterior flap. This defect is of course most marked when the limb is of considerable thickness at the seat of amputation, and shows itself in its most exaggerated form in the thigh of a muscular subject. Thus in a particular instance, where the development was by no means extraordinary, the dimensions were such, that, supposing the anterior transverse incision made at the level of the upper border of the patella, it would have been necessary, in order to preserve Mr. Teale's proportions, to saw the bone eleven inches further up, or full five inches higher than if the modified circular operation had been performed. This would most seriously have increased the danger, which is always greater the nearer the seat of amputation is to the trunk,† while, in case of recovery, the short stump would have been very inferior in usefulness on account of the slightness of the leverage it could have exerted in controlling the movements of an artificial limb.

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* Teale *On Amputation*, pp. 34 et seq.

† This principle has been pithily expressed by Dieffenbach in the words 'zollweise steigt die Gefahr.' (*Operative Chirurgie*, vol. ii. p. 822.)

The same disadvantage would often be experienced in applying the method to the leg. Near the ankle, indeed, where the limb is small and the anterior flap short in proportion, the operation is comparatively free from this objection. But if the circumstances of the case should render it necessary to amputate higher in the limb, the rapid increase of the thickness of the calf would necessitate a high division of the bone greatly out of proportion to the extent of the injury or disease of the soft parts. In a leg of about average development the amputation at Mr. Teale's seat of election, dividing the bones just below the calf, would require the integuments to be sound to the level of the tip of the internal malleolus. But if the skin happened to be unsound to a quarter of an inch above that level, the bones would have to be divided an inch higher; and a difference of three quarters of an inch in the skin would involve a loss of two inches of the bones; and again an affection of the integuments implicating less than two inches above the tip of the malleolus would require a division of the bones full four inches above Teale's seat of election. And in the last-named situation, where the calf is thickest, the very long flap, consisting in the greater part of its breadth of skin alone, would be very liable to suffer from sloughing.

From considerations like these some of the staunchest advocates of Mr. Teale's method are now disposed to restrict it to the lower part of the leg and just above the knee, where, by turning to account the integument over the patella, which is not used in ordinary operations, the anterior flap may be made of the requisite length without specially high division of the bone.

Mr. Carden proceeded upon a much more simple plan; forming a rounded anterior flap of integument only, without any posterior flap, and retracting the soft parts somewhat from the bone before dividing it with the saw; 'thus forming a flat-faced stump with a bonnet of integument to fall over it.'* This practice he began as early as 1846, nine years before Mr. Teale first employed his rectangular operation; and though refraining from publication, he obtained from that time forward most admirable results, both in safety to life and the amount of pressure that could be borne by the end of the stump.

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* See *On Amputation by Single Flap.* By Richard Carden, F.R.C.S., &c. p. 6. This is a reprint of an article in the *British Medical Journal*, April 1864.

It was principally at the knee, where amputation had not previously been much practised, that Mr. Carden applied his principle. The operation at this situation is thus described by him. 'The operator, standing on the right side of the limb, seizes it between his left forefinger and thumb at the spots selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through skin and fat below the patella to the spot pressed by his thumb; then turning the edge downwards at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards and the saw is applied,' through the bases of the condyles. 'Or the flap may be reflected first, and the knee examined, particularly if the operator be undetermined between resection and amputation. In amputating through the condyles, the patella is drawn down by flexing the knee to a right angle before dividing the soft parts in front of the bone; or if that be inconvenient, the patella may be reflected downwards.' *

This operation, when contrasted with amputation in the lower third of the thigh, presents a remarkable combination of advantages. It is less serious in its immediate effects upon the system, because a considerably smaller portion of the body is removed, and also because, the limb being divided where it consists of little else than skin, bone, and tendons, fewer blood-vessels are cut than when the knife is carried through the highly vascular muscles of the thigh; the popliteal and one or two articular branches being, as a general rule, all that require attention, so that loss of blood, whether from immediate or secondary hæmorrhage, is much diminished. In the further progress of the case the chance of exfoliation, with its attendent delay and danger, is greatly lessened by the division of the bone through the vascular cancellated tissue instead of through the shaft; while the tendency to protrusion of the bone, which causes so much inconvenience in amputation in the thigh, is rendered comparatively slight by the ample extent of the covering pro-

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* Op. cit. p. 6.

vided, and also by the circumstance that the divided ham-strings slip up into their sheaths, so that the posterior muscles have comparatively little power to produce retraction. The superiority of the operation is equally conspicuous as regards the ultimate usefulness of the stump, which from its great length has full command of the artificial limb, while its extremity is well calculated for sustaining pressure, both on account of the breadth of the cut surface of the bone divided through the condyles and from the character of the skin habituated to similar treatment in kneeling. Considering therefore that this procedure can be substituted for amputation of the thigh in the great majority of the cases both of injury and disease formerly supposed to demand it, 'Carden's operation,' must be regarded as a great advance in surgery.

It is also of great value with reference to the general question of the best mode of amputating in the lower limb. It confirms completely the conclusion which was, indeed, obvious enough from theoretical considerations, that there is no special virtue in the rectangular shape of the flaps advised by Mr. Teale, but that the advantages claimed for his method may be attained by much more simple means.

Nevertheless to extend the method by anterior flap of skin alone to the thigh and leg, as advised by Mr. Carden, does not seem to me judicious. A flap of integument alone, sufficiently long to cover the entire diameter of the limb, must be liable to the risk of sloughing, and I cannot but think it wise, when the muscular element is available for the purpose, to follow Mr. Teale's example by including it in the composition of the flap. An operation thus intermediate between those of Carden and Teale, with a rounded muscular anterior flap somewhat shorter than Teale's, and compensating for its diminished length and for the absence of a posterior flap by retracting the muscles before applying the saw, was practised in the thigh by Mr. Spence of Edinburgh before Mr. Carden published, and yielded very good results.* But this operation involves as high a division of the bone as Mr. Teale's, and it therefore became an important question whether its advantages might not be attained by some method free from this objection. The essential object to be aimed at is that, while the covering for the bone shall be ample, the tender cicatrix shall be placed sufficiently far back on the end of the stump to be well out of the way of pressure between the end of the bone and the bottom of the socket of the artificial limb. And if, consistently with attaining this object, the anterior flap could be shortened and eked out with a short posterior flap, it is plain that in exact proportion to the extent to which this was done would be the length of bone gained, with corresponding diminution of danger and increase of usefulness of the stump. Now it fortunately happens, both in the calf of the leg and in the thigh, that the bone lies far forward among the muscles, so that even its posterior surface is considerably anterior in position to the longitudinal axis of the limb. Hence a flap as long as two-thirds of the diameter of the limb would insure the scar being considerably behind the point of pressure; while a posterior flap half as long as the anterior one would be sufficient to complete the covering. The posterior flap, being short, may be made of integument only without any risk of sloughing, thus getting rid of the bulk, weight, and contractility of a posterior muscular flap. On the other hand the anterior flap, being still somewhat lengthy, should be raised so as to contain a good deal of muscle, which will be useful not only by ensuring sufficient vascular supply, but also by increasing the thickness of the cushion below the bone; while any tendency to retraction that it possesses (small compared with that of the posterior muscles) will be counteracted by the force of gravity, through which it will naturally tend to occupy its proper place.

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* *Edinburgh Monthly Journal*, Nov. 1859.

Such was the plan of amputating which I ventured to recommend for the thigh and the calf in the first edition of this work, on theoretical grounds which subsequent experience has only tended to confirm. The details of the method, as applied to these two situations respectively, will be found described in subsequent pages.

The dressing of the stump is a matter quite as important to the successful issue of amputation as the manner in which the limb is removed; and therefore requires special notice here.

Various as are the methods adopted by different surgeons for the purpose, they may all be classed under two heads, viz. that which, being hitherto in general use, may be termed the ordinary mode of dressing, and the antiseptic system.

The essential principles of the ordinary mode of dressing will be best understood from a consideration of the circumstances of the wound after the operation. The mechanical irritation resulting from the passage of the instruments through the parts appears to throw a thin layer of the tissues at the cut surface into a state similar to that produced by the action of cantharides upon the skin, or tincture of iodine upon the tunica vaginalis, viz. a condition of suspended vital activity, in which, the normal relations between the blood and the living solids being interrupted, the minute vessels become clogged with the blood-corpuscles, and coagulable plasma is forced through their parietes, and flows out upon the surface of the wound.* The fibrine of the coagulating plasma forms the lymph which encrusts the cut surface, while its other and far larger constituent, the serum, trickling away between the lips of the wound, shows itself as the discharge which soaks the dressings during the first twenty-four hours. Meanwhile, the original source of irritation being no longer in operation, the tissues, if free from any disturbing cause, are gradually recovering their powers by virtue of their inherent vital energy; and as they regain their functions, the effusion of plasma ceases, and a process of active organisation is instituted, by which the lymph is differently affected according to circumstances. If the surfaces of the wound are in juxtaposition, the lymph glues them together, and, being surrounded on all sides by healthy tissue, becomes developed in a few days into a vascular structure, which constitutes a permanent bond of union between them. But if the surfaces of the wound are separated by serum pent up in the interior, immediate union is of course prevented; and the serum, putrefying through atmospheric influence, irritates the tissues and gives rise to suppuration. And even though no serum be retained within the wound, if some persistent source of local irritation be present, such as the dragging of stitches upon an insufficient covering of soft parts, or a tightly constricting bandage, inflammation will be induced in a reflex manner, through the medium of the nervous system, and, in proportion to its degree, will interfere with the process of organic development; converting what promised primary union into suppuration; or, if more severe, rendering the lips of the wound entirely inactive, incapable of producing even pus; or, if still more intense, depriving them of their vitality, and causing sloughing of the stump.

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* See a paper, by the author of this Section, 'On the Early Stages of Inflammation,' *Phil. Trans.* 1858; also the Croonian Lecture 'On the Coagulation of the Blood,' *Proceedings of the Royal Society*, vol. xii. No. 56.

Thus, while the effusion of the lymph which is the medium of primary union depends on a species of traumatic inflammation of the cut surface, the healthy organisation of that lymph requires absence of any inflammation whatever; and the great object of treatment must be to place the stump in such circumstances that the tissues may be left undisturbed, to recover from the shock they have sustained and then exert their powers upon the product of their derangement.

Supposing, then, that the operation has been properly performed, so that the soft parts may meet over the bone without any tension, and that the orifices of the bleeding vessels have been carefully secured, the following simple rule will be found of universal application. Let the dressings be destitute of any irritating quality, and so arranged that the surfaces of the wound may be kept in gentle apposition throughout, while free opportunity is afforded for the escape of discharge.

The last point is of essential moment; for a flow of serum, copious in proportion to the extent of the cut surface, is, as we have seen, an inevitable effect of the operation; and though, when it has ready egress, it is probably beneficial, by washing out blood that may ooze into the wound before it has time to coagulate in the interior,* yet, if retained, it will prove mischievous, not only by rendering union mechanically impossible in the parts where it accumulates, but by irritating the stump, through the distension which it produces, and the acrid properties which it acquires from decomposition.

In the later stages of the case, it is equally necessary to provide for the free escape of discharge; for in a wound of such extent and irregularity as that resulting from amputation, we can never be secure against the formation of some pus in the interior, which, if retained, would give rise to all the evils of abscess. To guard against such an occurrence, the stump must be from time to time carefully examined. But if the operation be performed through healthy tissues, no suppuration will take place till about four days have elapsed; † so that any meddling with the stump before that time is unnecessary: and such premature interference does great mischief by tearing the yet imperfect and delicate uniting tissue.

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* The mixture of blood and serum which stains the dressings is very often mistaken by patients for bleeding.

† This is the period in adults and in cool weather; in young subjects and in warm weather, it is somewhat short of four days.

The records of Surgery show that a rapid cure after amputation has depended more upon the stump having been dressed in accordance with these principles, than upon the shape in which the covering of soft parts has been cut. In the original account of Lowdham's method, before quoted, Mr. Young states that the wound healed *per symphysin* in *three weeks*; and in describing the dressing, he says, 'Clap a dossil of lint into the inferior part, that one passage may be open for any blood or matter that may lodge between, but of that there seldom occurreth any.' The essential exit for the serum was thus provided; and it is to be remembered that Lowdham's flap was not a heavy and contractile mass of the muscles of the calf, but consisted only of the skin and fat, and therefore would lie in its place without tension.*

The stumps formed after Ravaton's fashion, with two lateral rectangular flaps, healed very quickly, both in his hands and those of Le Dran, who states that the cure was completed in three weeks; and accordingly we find that neither of these surgeons employed any irritating application, and that both were careful to leave the inferior longitudinal incision freely open for the escape of the ligatures and the discharges.† Ravaton insists especially upon this as a grand source of safety to the patient, and states that 'the drain which exists below prevents any mishaps, such as swelling, inflammation, abscess, &c.; no exfoliation of the bone occurs, and the suppuration is infinitely less abundant than in the old method, both because the wound of the stump has but a small surface or none at all, and because the inferior incision allows the pus to flow freely away; and in a short time this great wound in seen to be soundly healed.'

It seems strange, that after such results had been attained and clearly recorded in France, the surgeons of that country should afterwards have preferred stuffing with charpie the wound produced in amputation; and that O'Halloran, of Limerick, who wrote in 1765, and gained considerable reputation as a supporter of the flap method of amputation, while priding himself on his familiarity with the works of the French surgeons of his time, should have discredited altogether their reports of primary union, and considered that he did great service to Surgery in asserting the principle that 'healing by inosculation without suppuration, by an immediate coalescence or by the first intention, is merely chimerical, and is opposite to the rules of nature.'*

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* *Currus Triumphalis*, p. 111.

† Ravaton, *Traité des Playes d'Armes à feu*, p. 408; and Le Dran, Gataker's translation, p. 431.

But his influence was happily effectually counteracted, as far as British practice was concerned, by the teaching of Alanson, who was a warm advocate of primary union, both after flap and circular operations. Such success attended his practice, that out of thirty-five cases of amputation of the leg and thigh at the public hospital of Liverpool, he lost not a single patient; and he tells us that 'at the expiration of a month from the operation, the wound' was 'either perfectly healed or less than a sixpenny-piece.'† These results cannot be attributed entirely to good fortune; neither can they be explained by the peculiar conical form of the wound made by his oblique division of the muscles (which indeed did not occur in the leg amputations); but they are sufficiently accounted for by his after-treatment.

In the first place, he paid special attention to securing the vessels, examining 'the whole surface' of the wound 'with the greatest accuracy,' and drawing out the vessels with the tenaculum and tying them 'as naked as possible;' and, says he, 'no one will assert that in a single instance I have removed the dressings before the usual time, on account of hæmorrhage.' Secondly, in amputations of the thigh he employed a flannel roller, fixed round the pelvis and carried circularly down the limb, 'not so tight as to press rudely or forcibly, but to give an easy support to the parts;' and there is no doubt that such a bandage acts beneficially, not only by checking retraction of the soft parts, but by keeping the muscles in a state of repose, and thus preventing the disturbance of the process of union which would result from their irregular contractions. Thirdly, the edges of the skin, after his mode of operating, generally met without the slightest tension, and were retained in apposition merely 'by long slips of linen or lint, about two fingers in breadth, spread with cerate or any cooling ointment,' between which the serum would freely escape and soak into the rest of the dressing, which was simply 'a soft tow-pledget and compress of linen, the whole retained with the many-tailed bandage,' while the exit of discharge was favoured by the low position in which he placed the stump, viz. about a hand's-breadth from the surface of the bed. The dressings were first changed on the third or fourth day, and he advises that this should be done 'with as much tenderness as possible;' but the flannel roller was not interfered with till some time later, when the 'adhesions' were 'more complete.'

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* O'Halloran on *Gangrene*, &c. p. 220.

† Alanson, Preface, p. 16.

In short, the mode of dressing pursued by this excellent surgeon was in all respects truly admirable; and well would it have been for the credit of British Surgery had his successors been equally clear-sighted and judicious. But though all followed him in attempting primary union, their very anxiety to obtain it, not being supported by sound pathological knowledge, often led to entire failure. Thus Mr. Syme has informed us,* that when he was a dresser in the Edinburgh Infirmary, it was usual in recent wounds to bring the edges of the skin into close contact by strips of adhesive plaster overlapping at their edges, so as to allow no escape for blood or serum; and when these were removed, on the fourth day, a collection of fetid pus was almost invariably found separating the surfaces of the wound. So impressed was he with the evils of this practice, that he published in 1825 a paper on the subject,† in which he insisted on the invariable occurrence of a flow of serum, the retention of which was necessarily injurious; so that, as he expressed it, 'there can be little difficulty in perceiving why the sealing-up of wounds should be the most certain means of keeping them open;' and he pointed out 'that pressure should be directed to the bottom rather than to the outlet of the wound.' This paper had a very important influence, the principles inculcated in it being afterwards infused into London practice by the late Mr. Liston, besides being steadily taught and acted on by their author in the Edinburgh school. Mr. Liston continued to the last a practice which Mr. Syme at first suggested, viz. leaving the wound open for some hours before the final dressing, in order to obtain greater security against secondary hæmorrhage. But Mr. Syme afterwards found that, except in case of extensive oozing from minute vessels, the disturbance of the wound involved in this plan was an unnecessary infliction on the patient, and if sufficient pains were bestowed upon securing the arteries, the dressing might at once be completed. This consisted of points of the interrupted suture at sufficient distance from each other to afford a free outlet for discharges, and pads of folded lint applied over the bodies of the flaps, but not extending to the lips of the wound, with a broad piece of lint over all, and a bandage applied so as to press the deep surfaces of the wound gently together through the medium of the pads; while the cutaneous margins were left free for the exit of the discharge, which was absorbed by the lint as it escaped. This dressing was left undisturbed for about four days, when union was found already pretty firm; and a similar application being afterwards repeated at intervals of two days, the discharge of pus was commonly very trifling in amount, and the cure speedily accomplished. This was the method followed during my house-surgeoncy under Mr. Syme; at the expiration of which he was able to state, that 'of the last twenty cases in which he had amputated the thigh in that hospital for chronic disease, not one had died, although some of them were almost hopeless at the time of the operation, on account of the extreme degree to which they were prostrated by long-continued discharge or other causes.'* And there can be no doubt that one great reason for this success was, that the stumps were treated on sound principles.

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* Clinical Lecture in the *Lancet*, March 31, 1855.

† *Edinburgh Medical and Surgical Journal*, vol. xxiv.

Stitches are preferable to strips of adhesive plaster for keeping the edges of the skin in contact, as they occupy much less room, and so oppose less obstacle to the escape of discharge; and the only objection ever urged against them, viz. that they induce inflammation round the points where they are inserted, was entirely removed by the introduction of the metallic suture, which, unlike a silk or linen thread, that becomes acrid from putrefaction among its fibres, causes no irritation whatever, unless it subjects the part to traction, and this ought never to be the case after amputation. When applied without tension, the wire stitches may remain for any length of time, without producing more disturbance than a ring of gold in a lady's ear;† they consequently retain their hold for a much longer period than silk or linen, so that strapping may usually be entirely dispensed with, which greatly simplifies the dressing.

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* Clinical Lecture, *Lancet*, April 21, 1855.

† I am happy to be able to confirm fully the original statement made on this subject by Dr. Sims of New York, to whom the profession is indebted for demonstrating the value of the metallic stitch. For passing the wire smoothly through the tissues, a needle suggested by myself some years ago will, I believe,

Though a padding of some soft material suited for imbibing the discharge, and arranged according to the principles indicated above, does good by giving general support to the stump, and keeping the deep surfaces of the wound together, and so checking oozing of blood and promoting union, yet it has the disadvantage of affording a nidus for putrefaction. Accordingly, it was proposed twenty years ago by Professor Humphry, of Cambridge, to dispense with all dressing whatever, and leave the wound exposed to the air, so that crusts of inspissated blood and serum might form over the intervals between the stitches when oozing had ceased, and healing might proceed as under a scab.* This plan has been especially followed in conjunction with the method of arresting hæmorrhage by the temporary pressure of needle or wire introduced by the late Sir James Y. Simpson, under the title of 'Acupressure.' It has been proved that even a vessel as large as the femoral artery may remain permanently occluded if a needle be pinned down across its calibre at a little distance from its cut extremity, and removed after 24 or 48 hours. The *modus operandi* is, I presume, that the irritation of the compressing needle induces the formation of a coagulum, and its adhesion to the wall of the vessel, at the point compressed, in addition to and continuous with the clot at the divided extremity; so that the plug of coagulum, thus increased in length and made more extensively adherent, becomes efficient for resisting the impulse of the blood even in so large a tube. And I may remark that, if acupressure is employed for vessels of such calibre, I believe it to be of essential moment that the needle should be so arranged as to compress the artery at some little distance from the cut end. For smaller vessels, it is sufficient that the bleeding point itself be acted on, whether by twisting with a needle introduced into the tissues beside it, or by some other of the ingenious means devised for the

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be found the most convenient. It is grooved at each side, from the eye to the blunt end, these points being further from one another than in an ordinary needle. Care must be taken to hold the wire in the grooves while twisting its ends together, after which it will be found securely incorporated with the needle. It will, however, be seen from the sequel that under antiseptic management we may return with advantage from the rigid wire to stitches of more pliant material.

* See *Med.-Chir. Trans.* vol. xli.

purpose.* The needles or wires, while they remain in position, fail to conduct putrefaction into the interior, like porous ligatures of silk or flax, and after their removal within the first 48 hours, the wound is left free from any foreign body. It is pre-eminently for amputation that these two methods of acupressure and absence of all dressing are applicable; for the ends of stumps can be left exposed to the air more easily than most other parts, while from their shape they are peculiarly suited for the convenient application and withdrawal of the needles. And in the hands of some surgeons, more especially Professor Pirrie and Dr. Keith, of Aberdeen, results of the most brilliant character have been attained, large wounds, like those after amputation in the thigh, healing with great rapidity without the formation of a drop of pus.†

There is, however, another side to this picture. During an extensive trial of acupressure in very competent hands in the Glasgow Royal Infirmary, secondary hæmorrhage occurred on several occasions: and even admitting that this was in some instances due to a faulty application of the method, and especially to want of attention to the point above alluded to regarding vessels of large calibre, yet the general impression conveyed was that acupressure failed to maintain its position in the essential point of thorough efficiency as a hæmostatic means. And I doubt whether it be possible for any surgeon, after withdrawing the needle from an artery like the femoral, to leave his patient with the feeling of entire safety that he has when the vessel has been secured by ligature. Again, the needles and wires, especially when numerous, have sometimes become entangled in the wound in a very inconvenient manner; and I have heard of a case in which it was necessary to break open the entire extent of the uniting flaps before they could be extracted. But not to lay too much stress upon occurrences like this, which may have been due to mismanagement, there remains another serious drawback to the method. The primary union, which is so beautiful when it occurs, cannot be reckoned on as invariable, and if putrefactive suppuration does occur in the interior, it is apt to produce effects all the more mischievous from the want of outlet occasioned by the complete closure of the wound externally.

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* See *Acupressure*, by James Y. Simpson, M.D., F.R.S.E., &c.

† See Pirrie on *Acupressure*.

Hence, for my own part, I confess I should have felt in considerable difficulty, dazzled and attracted by the splendid success of acupressure in many cases, but repelled by the fear of hæmorrhage or of abscess, had it not been for the introduction of the antiseptic system, which, in a different way, attains the same objects more securely.

The main principles of the antiseptic system are well illustrated by a case of simple fracture, say a fracture of the leg from direct violence. Such an injury, though subcutaneous, is a most severe contused and lacerated wound; and the interstices between the mangled tissues are loaded with extravasated blood. With the sole exception that the skin is not divided so as to expose the injured parts to the atmosphere, there are present in an aggravated form those conditions which we used to regard as inevitably involving violent inflammation, followed by the separation of sloughs under suppuration, with corresponding constitutional disturbance and serious attendant risk of fatal blood-poisoning. Yet, thanks to the unbroken integument, all proceeds quietly and surely towards recovery: the effused blood is absorbed; and any portions of tissue killed by the violence are similarly disposed of; while repair is effected by a process which, though more slow, in consequence of the larger amount of effete material to be worked off, is identical with that union by the first intention, which is commonly supposed to demand cleanly-cut surfaces with accurate apposition. If, therefore, the effects of atmospheric exposure could be avoided, primary union ought to occur under circumstances hitherto believed to be inconsistent with it, and our wounds, whether incised or contused, should follow the same safe and tranquil course as subcutaneous injuries.

In order that we may attain this all-important object, the first essential is that we understand clearly how the atmosphere exerts its baneful influence. If an open contused wound is treated in the ordinary way, say by water-dressing or fomentation, we know as matter of observation that the blood within it undergoes putrefaction as if exposed to the air at the same temperature in a vessel of glass or other inert material. This fact explains the whole train of bad consequences. The products of putrefaction are irritating and poisonous substances; and, though perfectly harmless when applied to a sore covered with granulations, which constitute a protecting layer destitute of sensibility and readily excited to suppuration instead of absorption, act very differently upon a recent wound, which violently resents the contact of the poison, yet helplessly imbibes it into the circulation: the inevitable result being local inflammation and febrile disturbance. Meanwhile such portions of tissue as have been killed by the violence of the injury, instead of retaining their original bland character, and serving as pabulum for their living neighbours, become constantly more and more acrid from progressive putrefaction in their substance, and not only irritate the weakened parts in their vicinity and retard their recovery, but operate upon them with caustic effect, and thus extend the loss of vitality greatly beyond its original limits. The persistent abnormal stimulation at length gives rise to suppuration, which weakens the patient in proportion to its amount, and in severe cases often carries him off by hectic and occasionally by pyæmia.

But however clear might be our conviction of the evil effects of putrefaction in wounds, it was hopeless to try to prevent it so long as the oxygen of the air was supposed to be its cause. In small wounds, indeed, attempts had been made with varying degrees of success to exclude the air entirely, either by a crust of inspissated blood or by hermetically sealing with collodion. But in wounds of any considerable size provision must be made for the escape of blood and serum, with which the atmospheric gases, from their diffusibility, could not fail to mingle. But the problem assumed a totally different shape when it was shown, chiefly through the philosophic labours of Pasteur, that putrefaction is not occasioned by the chemical action of oxygen or any other gas, but is a species of fermentation, analogous to that of sugar under the influence of the growing yeast plant, being brought about by the development of microscopic organisms, the germs of which, from their extreme minuteness, float in abundance in the air as constituents of its dust. This being once clearly understood, it is plain that putrefaction in wounds may be avoided without excluding the air, by dressing them with some agent capable of destroying the vitality of the atmospheric organisms, provided that it does not act with too great violence upon the human tissues. We have long been familiar with materials which poison infesting parasites without excoriating the skin, as, for example, the various washes and unguents used for killing pediculi and their ova, or sulphur ointment for the destruction of the acarus scabiei. For the purposes of antiseptic treatment, *volatility* of the germ-poison is an essential requisite, in order that the atmosphere round the dressings may be deprived of septic energy, so that no harm may arise from its introduction into the wound, which it is often quite impossible to avoid. There are many agents which fulfil the conditions of volatility combined with hostility to low forms of life, such as chlorine, sulphurous acid, benzine, creasote, and carbolic (or phenic) acid. Any one of these, as I have ascertained by experiment, may be used so as to keep a wound from putrefaction, provided it be employed with the essential object kept steadily in view, that is to say, to prevent the possibility of a single living putrefactive organism being left in the wound at the conclusion of the first dressing, or gaining access to it subsequently.*

Carbolic acid happened to be the first agent that I employed on this principle; and it still appears to be the most convenient for the purpose. Besides being remarkably efficient in the form of vapour, it is miscible with a great variety of different substances, such as water, the fixed oils, and various resins: and such mixtures have each its own peculiar value with reference to our object in the treatment. Water holds the particles of the acid very feebly, and therefore liberates them readily to act upon any other substance. Hence a watery solution, besides being a cleanly lotion, is very potent in its immediate action, but very transient: exactly the properties we desire for an application to a wound designed to kill once for all any septic organisms that may have lodged upon it, and then leave the tissues as free as possible from further irritation. Common resin, on the other hand, holds the acid with remarkable tenacity, and even at the temperature of the body gives it off very slowly; so that a large proportion of the antiseptic may be kept stored up in the resin in a form which acts very mildly, but for a long period. These are the qualities required for an external dressing to guard against the penetration of putrefactive fermentation from without; while the insolubility of resin in water prevents it from being washed away by the discharges. The fixed oils occupy an intermediate position as regards their hold upon carbolic acid, and there are circumstances in which they form a most convenient vehicle for it. Carbolic acid has also the advantage of being a local anæsthetic, exercising a soothing influence upon a raw surface to which it is applied; while the disagreeable smell, which at one time was a serious objection to it, has been almost entirely removed by

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* I am glad to observe that the doubts which have been thrown upon the germ theory in some quarters, which I fear have not tended to raise the scientific reputation of our profession, are being more and more dispelled as the subject is submitted to further discussion. (See, for example, Professor Huxley's Address at the Meeting of the British Association in Liverpool last year: 1870.) Among recent contributions of fact to the elucidation of this question may be mentioned Professor Tyndall's simple but beautiful proof of the existence of organic particles of dust of excessive minuteness in the air by means of a condensed beam of light; and the equally clear ocular demonstration afforded by the same method, that even the finest particles are capable of being removed from the air by causes which Pasteur, in some of his experiments, inferred must clear it of suspended organisms, such as the action of gravity and filtration by cotton wool. The fact last named seemed to promise valuable results in antiseptic surgery, and experiments made with this view have afforded further evidence in favour of the germ theory which it may be well to mention here. I found that if cotton wool, impregnated with either chlorine or sulphurous acid gas, or with the vapour of benzine or carbolic acid, was placed upon a wound or granulating sore, after washing the surface with a lotion containing the same agent, although the volatile antiseptic left the cotton in about a day, the blood or pus still effused beneath the cotton remained free from putrefaction for an indefinite time, provided that the discharge was not sufficiently copious to soak through the cotton and appear at the surface, in which case the meshes between the fibres affording ample space for microscopic organisms to develop in, putrefaction spread within a few hours throughout the moistened part of the mass. This circumstance greatly interfered with the practical utility of the dressing, and it has since been superseded by the 'antiseptic gauze,' to be described in the text; but the facts seem to me important with regard to the germ theory. The cotton wool, though it loses all chemical antiseptic virtue in a day, yet will keep out putrefaction for a month or more. It cannot possibly keep out any atmospheric gas, which is necessarily diffused freely between its

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fibres, and gets in for the same reason that the volatile antiseptic gets out. That which it does exclude *can* only be suspended particles of dust. It follows, therefore, as a matter of certainty, that the causes of the putrefaction through atmospheric influence of blood or pus, or, in other words, such materials as the surgeon has to deal with in treating wounds, are not the atmospheric gases, but dust. And the fact that this dust is deprived of its putrefactive energy by agents which are chemically so unlike as chlorine, sulphurous acid, benzine, and carbolic acid, but which agree in having a common hostility to animal or vegetable life (I used benzine because I knew that the entomologist employs its vapour to kill insects)—this fact confirms the view that the putrefactive particles are really organisms. I commend these simple experiments with cotton wool to the candid judgment of the reader, because, whatever may be thought of their bearing upon the allied subject of spontaneous generation, they must be allowed to afford absolute demonstration of the truth which is the foundation of the antiseptic system, viz. that the putrefaction of blood or pus under atmospheric influence is caused not by the gases of the air, but by suspended particles, which can be deprived entirely of their septic energy by the vapour of an agent like carbolic acid.

purifying it of the stinking compounds associated with it in the crude product.

In dealing with an accidental wound, it is necessary first to kill any septic organisms introduced into it from the air or from contact with foreign bodies, and, supposing carbolic acid to be the agent employed, this is done by washing the cut surface thoroughly with a saturated watery solution (one of the acid to twenty of water); but even this is felt to be a somewhat uncertain process, because some mischievous particle, lurking in some interstice among the tissues, may possibly elude the action of the lotion, and subsequently propagate its kind and spread putrefactive fermentation throughout the wound. For it is important to bear in mind that the acid applied to the interior has no persistent antiseptic effect, but is speedily dissipated, being partly washed away by the discharge, and partly absorbed into the circulation. When, however, the wound is made by the surgeon himself in a previously unbroken integument, he has it in his power to prevent putrefactive organisms from ever entering it alive, by operating in an antiseptic atmosphere in the form of a cloud of spray imbued with the acid,* while the sponges are rendered harmless by wringing them out of a watery solution, the fingers of the surgeon and his assistant having been dipped in the same, and the saw and other instruments smeared with oil containing about a tenth part of the agent. The spray, when efficient, besides fulfilling its main object of rendering the first stage of the treatment secure, has the advantage of permitting us to reduce the strength of the lotion, which is then no longer required to destroy organisms lying in the recesses of the wound, but merely to ensure the aseptic character of sponges and other foreign bodies introduced into it. For this purpose as small a proportion as one part of acid to a hundred of water is sufficient, whereas, if the spray is not used, I do not feel justified in recommending anything weaker than one to forty. The milder lotion is not only a great relief to the surgeon's fingers, but saves needless irritation of the cut surface. The wound must be covered with a cloth dipped in the lotion during any periods of suspension of the spray, which should, with such exceptions, be continued throughout the entire process, including the securing of the vessels and the introduction of the stitches.

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* I have in view a set of experiments for determining the limits of weakness of solution, and fineness of spray, that may be trusted for producing an antiseptic atmosphere. Meanwhile, I can recommend for the smaller amputations the use of Richardson's apparatus for local anæsthesia with the 1 to 40 watery solution of carbolic acid substituted for ether. This we have already proved to furnish an absolutely trustworthy spray, though probably needlessly coarse and strong. For the larger amputations a larger cloud is requisite; and I hope we may have before long a simple and cheap means for the purpose; the machine which I have had constructed for my own use, though efficient, being too cumbrous and expensive.

The antiseptic catgut ligature constitutes an important element in the system. When properly prepared,* it seems to fulfil all the conditions of a perfect hæmostatic, combining the absolute security and universal applicability of the ligature with virtual absence of any foreign body from the wound. For if putrefaction is avoided, the knots and short cut ends are absorbed with as much certainty as the clots and pieces of dead tissue in a simple fracture, and, however numerous they may be, do not in the least interfere with primary union; while, if putrefaction chances to occur, we may guess that such of them as are actually exposed to putrescent liquids must ultimately soften down and come away, like the other minute sloughs of cellular tissue which appear along with the pus; but this is merely matter of presumption, for I have never observed the catgut knots come away, nor have I ever seen abscess occasioned by them, although I have constantly used this ligature during the last two years, and putrefaction has occurred in many cases during that period. And I may add that I have never known secondary hæmorrhage caused by the use of the catgut.

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* It is of the utmost importance that the catgut should be rightly prepared; for, if merely imbued with an antiseptic salt, it is utterly unfit for surgical purposes, becoming soft and slippery when moistened, so that it will neither bear the requisite strain nor keep its hold when tied. But it is a happy circumstance that the animal tissue (the peritoneum with some unstriped muscular fibre from the sheep's intestine) undergoes a remarkable physical change if suspended for some weeks in an emulsion of water and oil, in which, after growing soft and opaque during the first few days, it gradually experiences an alteration of an opposite character, and at length becomes again quite transparent, and is then little affected by water, and holds better when tied than waxed silk. The emulsion is best made by mixing one part of crystallised carbolic acid, deliquesced by means of water, with five parts of olive oil. The very fine emulsion that results is placed in a covered jar having a partition of glass or other material, supported by pebbles at a short distance above the bottom, to afford space for the water that slowly subsides to accumulate in, and keep it from coming in contact with the hanks of gut which are packed loosely in the upper part of the vessel. The process of preparation goes on best in a cool place, and should be continued at least two months; and the gut goes on improving in quality for an unlimited period, if retained in the same oil. For carrying in the pocket-case, I have had a narrow winder inclosed in an appendage to a metallic caustic-holder (to be had of Young or Gardner, cutlers, Edinburgh). This will receive a supply of about twelve yards, which may be kept for any time in this receptacle without losing its antiseptic virtue.

Anyone desirous of convincing himself of the absorption of catgut has only to employ it for sutures and treat antiseptically, and in a few days he will find the knots come off with a touch, the part of the stitch imbedded in the tissue having disappeared. This circumstance renders the catgut unfit for sutures intended to retain their hold for a considerable period, for which some material less amenable to absorption by the tissues is to be preferred, such as silk thread with the interstices among the fibres filled up with wax containing about a tenth part of carbolic acid.* This material is very superior to wire, not only on account of its perfect suppleness, but because its actively antiseptic character ensures absence of putrefaction in the track of the stitch. The spray is never more useful than in the introduction of the sutures. If it be not employed, the wound must be injected with lotion after the insertion of the last stitch, to destroy any mischief that may have entered through regurgitation of blood that oozes into the cavity during the sewing—a troublesome and uncertain process which the spray enables us to dispense with entirely.

The wound being thus free from the elements of putrefaction at the completion of the operation, it remains to carry out the other division of the antiseptic treatment, viz. to apply such an external dressing as shall securely guard for the future against the penetration of septic fermentation from without. For this purpose the most convenient material I have yet arrived at is the 'antiseptic gauze,' made by impregnating a cotton cloth of open texture with a mixture of carbolic acid, resin, and paraffin, in which the resin serves as the vehicle for the acid, while paraffin is added to prevent inconvenient adhesiveness.†

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* The acid is mixed with melted bees-wax, in which the silk is then placed, and, when thoroughly steeped, drawn out through a cloth to remove superfluous wax.

† The proportions which I have found best are: 1 part of carbolic acid, 5 parts of resin, and 7 parts of paraffin. The gauze is very readily prepared by passing the cloth in several layers between a pair of rollers after dipping into a

This dressing, while it absorbs discharge, holds the antiseptic securely lodged in its fibres, where it is retained by the insoluble resin, and it is to this circumstance that it owes its superiority over most other porous applications.* It is wrapped round the stump in about eight layers, and during the first few days, while there is a copious effusion of serum, it is well to surround it with some impermeable tissue,† to prevent the discharge from passing directly outwards, and compel it to travel along the whole extent of the antiseptic investment, which should reach several inches up the stump. The gauze is also extremely useful in the form of antiseptic bandages, whether to check a tendency to retraction of the soft parts of a stump or for securing and completing a dressing. If strapping is required, common adhesive plaster may be rendered antiseptic by dipping it for a second or two in a watery solution of the acid, and it is most convenient to have the lotion hot (say one part of one to twenty with two parts of boiling water), so that the strap is warmed at the same time by its immersion. It can then be applied effectively under the spray, which should always be used in changing the dressings of a stump till the wound has become superficial. The antiseptic atmosphere not only affords perfect security against the introduction of mischief, which it would otherwise be extremely difficult to avoid, but has the great advantage of permitting free inspection and manipulation of the stump. When the spray is intermitted, the wound must be covered with a ‘guard’ of rag dipped in the lotion. The ends of the adhesive straps should be over-

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steam-heated trough containing the melted mixture. The cloth is thus left with rather less than its own weight of the mass, the individual fibres being charged, but the interstices open. Or the superfluous material may be squeezed out by a press with heated metallic plates: though this gives a less uniform result than the rollers. For hospital purposes the clothes may be washed and re-charged over and over again, to save expense.

* Oakum acts on the same principle, and indeed suggested to me the idea of the gauze. In oakum, it may be remarked, the antiseptic is not carbolic acid, but creasote.

† The best material I know for this purpose is a light kind of mackintosh cloth sold at all india-rubber depôts, consisting of very fine calico with a film of caoutchouc on one side. Gutta-percha tissue of good quality will also answer; but it is liable to wear into holes, and so is less secure and in the long run more expensive than the mackintosh, which may be used over and over again for a long time. I find it best to place the mackintosh beneath the outermost layer of the gauze; both to prevent it from shifting its place and for the sake of greater security antiseptically in case of any accidental perforation in the tissue.

lapped by the gauze, to prevent them from subsequently conducting putrefaction inwards. While discharge is free, the dressing should be changed daily; but as it diminishes, the intervals may be increased, till, when there are merely a few minims in twenty-four hours, the gauze may be left undisturbed for a week together.

Besides these antiseptic precautions, there are two other points essential to bear in mind in carrying out the treatment, viz. to provide for the due escape of serum and to protect healing parts from the irritating influence of the antiseptic salt. The effusion of plasma which occurs during the first few hours after the infliction of a wound is greater when the cut surface has been treated with a stimulating wash than it is under ordinary management; and unless provision be made for its escape, it will be pretty sure, in a wound of such depth and extent as that of a major amputation, to accumulate in sufficient quantity to cause inflammatory disturbance from tension. On the other hand, when once the antiseptic introduced at the time of the operation has left the wound, provided that irritation be not perpetuated by blood and serum pent up in sufficient quantity to cause disturbance, or by some other accidental circumstance exciting the nerves of the part, such as tightly dragging stitches, we may reckon with confidence on the discharge being trifling in amount. Hence it is only during the first twenty-four hours that a special provision for its escape is needed; and for this purpose I have found it convenient to lay in the wound a strip of lint soaked with an oily solution of carbolic acid (one to ten), one end being left hanging out at the most dependent part, to serve as a drain for blood and serum. This is introduced before applying the sutures, which at all other parts of the wound may be inserted more closely than is customary. The oily solution is preferred to that in water, because it greatly facilitates the extraction of 'the drain,' which is effected on the first or second day after the operation in a cloud of thoroughly trustworthy spray; otherwise the air that passes in to take the place of the lint would infallibly produce putrefaction.* If, through neglect or insufficiency of the drain, disturbance from tension should arise, it would in time, if unrelieved, cause inflammatory suppuration, which must be carefully distinguished from that occasioned by putrefaction. For if the abscess is evacuated antiseptically, whether by opening up the former wound or by a fresh puncture in the skin, there will probably be no further formation of pus, any more than in an ordinary abscess similarly treated; whereas, if the suppuration were regarded as derived from atmospheric influence, the mistake might lead the surgeon to abandon his antiseptic management altogether.

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* If a spray-producer be not at hand, a trustworthy antiseptic atmosphere in which to withdraw the drain may be obtained by covering the region of the wound with a large piece of rag dipped in one to twenty watery solution, and extracting the lint with a pair of dressing forceps introduced beneath the cloth. This was the method which I followed before the introduction of the spray, and with uniformly satisfactory results.

It is always to be remembered that the antiseptic is in itself an evil, so far as its direct influence upon the tissues is concerned. Of this we have just been considering one instance in the increased flow of serum from the cut surface induced by the action of the lotion upon it; and it is well to recollect that the mere washing of the surface with the acid, unless followed up by strict antiseptic dressing, would leave the wound in a much worse condition as regards the chance of primary union than if it had not been interfered with; so that it is better not to attempt this treatment than to do it by halves. Another example of the same thing is presented by the retardation of cicatrization observed when the acid is allowed to act immediately on the margins of the wound. Carbolic acid operates with especial energy on the cuticle; and even when far too dilute to produce excoriation, that is to say, to destroy the perfect epidermis, it will often entirely prevent the production of the young epithelial cells. It is therefore necessary to protect the cicatrizing part by interposing between it and the gauze a layer of some impermeable material. Carbolic acid is a remarkably penetrating substance, passing through gutta-percha or india-rubber with the utmost facility, though not dissolving them; and it has been somewhat difficult to devise an efficient 'protective.' The best we have yet obtained is oiled silk, coated on both sides with copal varnish, to render it less permeable to the acid, and afterwards brushed over with dextrine, to enable it to become uniformly moistened when dipped into a watery solution. It is thus immersed just before being laid upon the wound, in order that it may have an antiseptic film at the moment of application, to make sure that no active septic particles are put on along with it.* The trifling amount of the acid thus inevitably applied to the wound every time it is dressed is very soon dissipated, after which the true function of the protective comes into play;* and the dressing, as a whole, consisting of an antiseptic to keep out putrefaction and an unstimulating protective to exclude the antiseptic, takes very much the place of the unbroken skin in the simple fracture, in preventing entirely the disturbing influence of external agency. Thus we have, under a moist dressing, the same mode of healing as has long been familiar in small wounds beneath a scab; and while the grievous results of putrefaction are avoided, cicatrization proceeds more rapidly than under water dressing.

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* Common oiled silk smeared with the oily solution will answer the purpose pretty well, especially if used in two layers. In preparing the protective

Though the principles of this treatment have demanded a somewhat lengthy discussion, its practice will be found by no means difficult or complicated. It requires no special skill; and the care which it is essential to take soon becomes habitual and instinctive, and in the aggregate saves the surgeon a great deal of time, besides relieving him of a load of anxiety. For when a few days have passed without putrefaction, the dressings may be left unchanged for several days together, while at the same time the patient is felt to be absolutely secure against the various risks of pyæmia, erysipelas, hospital gangrene, necrosis, osteomyelitis, or exhaustion from profuse suppuration. Surely these are advantages well worthy of our best efforts to attain them.

Unhappily, however, too many cases present themselves for amputation for which this treatment is inapplicable, through the presence of sinuses occasioned by abscess from diseased bone having been allowed to open spontaneously, or having been evacuated by incision without antiseptic precautions. It would

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described in the text, when the copal varnish has dried, a mixture of one part of dextrine, two parts of starch, and sixteen parts of cold watery solution of carbolic acid, is brushed over. The granular starch enables the dextrine solution to apply itself better to the varnished surface, and the solution of carbolic acid is used rather than mere water for the same purpose. The acid soon evaporates, and leaves the protective free from stimulating properties.

* It is perhaps necessary to utter a word of caution against the improper use of the protective, which, if its principle is not kept clearly in mind, may be employed so as to have the most disastrous effects. All that lies beneath this layer is intended to be *aseptic*, but not *antiseptic*, and will putrefy at once if any active septic particle gains access to it. If, therefore, the protective were allowed to project beyond the gauze, it would simply serve to conduct putrefaction inwards to the wound. The protective must always be overlapped by the antiseptic dressing as freely as if it were a wound.

obviously be useless to operate in an antiseptic atmosphere, and employ an antiseptic dressing, if putrefaction existed in a sinus left in the stump; while to amputate above the utmost limits of sinuses or abscesses would often be quite unjustifiable. When the importance of the antiseptic management of abscesses becomes fully recognised by the profession, cases of this kind will be less common than they now are. Meanwhile, we must deal as best we may with these results of misfortune or mismanagement. And here the solution of chloride of zinc, introduced by Mr. Campbell de Morgan, possesses a very high value. This salt, when used in pretty large proportion to water, say about forty grains to an ounce, has the great peculiarity of producing a persistent antiseptic effect upon a cut surface; and, as the result of a single application, prevents the occurrence of putrefaction for days together, in spite of the immediate vicinity of active septic agency. This is perhaps most strikingly exemplified by its effects on wounds resulting from the removal of tumours of the jaws. Here the cavity of the mouth perpetually supplies fresh septic agents; yet if the raw surfaces are well brushed over with the chloride solution before the edges of the skin are stitched, the breath will remain from day to day free from the fœtor which was formerly so distressing after such operations, while a great deal of the inflammatory disturbance occasioned by putrefaction is averted. Similarly, in the case of amputation through a part affected with sinuses, if the cut surfaces are treated with chloride of zinc, the causes of putrefaction left lurking in the sinuous tracks are incapable of communicating putrefaction to the rest of the wound till three or four days have elapsed, when granulations are more or less completely formed to protect the cut surface from the evil effects of the contact of putrid material. The discharge occasioned by this application being very free, special care must be taken to leave ample room for its escape; and indeed it is sometimes best to abstain from the use of stitches altogether for the first few days: for if the serum accumulates in the stump, putrefaction occurs much earlier than it otherwise would.

Before commencing the operation, an attempt should be made to correct entirely the pre-existing putrefaction in such cases. With this object, the skin having been thoroughly cleansed of inspissated discharges,* the sinuses should be freely injected with the chloride solution by means of a powerful syringe, the part being at the same time manipulated, in the hope that the antiseptic may be forced to penetrate to their furthest recesses. After the removal of the limb, when the cut surface has been treated with the solution, the stump is wrapped in gauze as usual, and the spray is employed in the changing of the dressings. Under this practice, a certain proportion of cases will remain entirely free from putrefaction; while in those in which it does occur, its effects will be greatly mitigated.

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* I find it well in cases of this kind to have a cloth, dipped in one to twenty watery solution of carbolic acid, wrapped round the limb a few hours before the

Before considering the operations best adapted for particular cases of amputation, it will be well to allude in a general way to the necessary instruments, and the mode of using them.

The amputating knife should have a straight and strong back, and a sharp point, near which the edge should present a gentle convexity. In the old circular amputation, a curved knife with a blunt extremity was employed to divide the integument at one continuous sweep; but as the modified operation is always preferable, in which the skin is cut in the form of short semilunar flaps, this somewhat clumsy implement may now be entirely dispensed with. For a flap operation performed by transfixion, the blade should be about half as long again as the diameter of the limb; but when the soft parts are cut from without inwards, a much shorter knife will answer the purpose, and should therefore be preferred, as the movements of the smaller instrument can be directed with greater precision and speed. For removing a finger or toe, something intermediate between the tapering bistoury often used in France and the old round-bellied English scalpel will be found to combine the advantages of both, without the inconveniences of either, being equally adapted for piercing and cutting.

In using the knife, the young practitioner will have to unlearn some of the habits he has acquired in anatomical study. The object being now simply to divide the resisting textures efficiently, the stroking and scratching movements of the dissecting-room must be changed for a free sawing motion: and for this purpose the knife must be held firmly in the hand, instead of being kept in the feeble position best suited for the investigation of delicate structures.

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operation, at the part where amputation is to be performed, so as to make sure of thorough purification of the integument. In ordinary cases, it is sufficient to sponge the surface of the skin with the lotion immediately before operating.

There is another error to which the habits of dissection may lead, far more serious than a cramped and awkward use of the knife, viz. that of directing the edge of the instrument towards the skin in raising a flap of integument. Such a practice, necessary in anatomy, in order to leave the subcutaneous structures intact, will, if carried into amputation, most seriously endanger the vitality of the flap, which derives its supply of nourishment from vessels ramifying in the fat, and must perish if those vessels are extensively divided through scoring of the *tela adiposa.* I am satisfied that integument designed to form a covering for the stump is often made to slough for want of scrupulous attention to this simple point.

The skin should always be cut perpendicularly to its surface, for if it is bevelled off to a thin edge, it is not only unsuited in shape for adaptation with a view to primary union, but the margin may slough for lack of nutriment.

In transfixing a limb, the direction of the knife must of course be changed as it passes round the bone, in order that it may emerge at the opposite aspect; but it is desirable that this should be done in a contiuous manner; for if the instrument be thrust in for a certain distance, and then partially withdrawn and made to follow a new track, the punctured wound first made may cause very troublesome hæmorrhage, if a considerable arterial branch happen to be divided in it.

In passing the knife round a bony prominence, such as the shoulder, care must be taken to hold the limb in such a position as shall relax the parts that are to be pierced, otherwise what might be quite easy may prove impossible; and in the latter part of the process, when the point of the knife is advancing in a greatly altered direction, it is important to keep the back rather than the edge directed outwards, in order to avoid cutting the base of the flap.

In amputating at a joint, if the tissues are healthy, the division of the soft parts completes the process, there being no need to take away the articular cartilage, which is almost as favourably circumstanced for healing as vascular structures. Thus, when a finger is removed at the metacarpo-phalangeal joint, the whole wound may unite by first intention; or if suppuration occurs, the cartilage undergoes a change into granulations by a process so speedy as hardly to delay the cure.

The saw, for dividing the bone in other cases, should be broad-bladed, with a stout back, like the 'fine saw' of the carpenter, and should have small but well-set teeth. In applying the instrument, its heel being placed upon the bone, previously cleared of soft parts by a circular sweep of the knife, it should in the first instance be drawn with firm pressure towards the operator, so as to make a groove which it will have no disposition to quit in the first forward stroke. The bone is thus cut precisely at the place desired, while any scratching of the neighbouring parts of the osseous surface is avoided, which, besides involving loss of time, might give rise to a small exfoliation.

The assistant who holds the limb must take care not to press it forcibly upwards, otherwise the saw will become locked; nor must he draw it downwards to any great degree, or the bone will break and splinter towards the last. But the operator should always be so placed as to be able to control with his left hand the part which he removes. Should any projecting portion be left, it must be removed with a pair of bone-pliers, which may be substituted entirely for the saw when the bone is of very small size, as in the fingers. In using them, the flat surface should always be directed towards the parts that are to be preserved, as the other sides of the wedge-shaped blades crush the bone while they divide it.

The tenaculum, long universally employed for seizing the bleeding vessels in order to tie them, has been superseded by the catch-forceps, which, like the bone-pliers, were introduced into surgical practice by the late Mr. Liston. Besides being always more convenient, they have the great advantage of making the surgeon independent of an assistant in cases of emergency. The ligature should be tightly and securely tied, by reversing in the second half of the knot the relation that the ends of the thread had to one another in the former half, or, in the language of sailors, by making a 'reef-knot.' The larger vessels should be drawn a little way out of their sheaths, as the best means of avoiding nervous trunks and other unnecessary tissue. Of the smaller branches, as a general rule, all that are seen to pulsate should be tied, mere oozing being checked by the gentle pressure of the dressing; but in order to render conspicuous all that require tying, it is safest, before dressing the stump, to put the surfaces of the wound in apposition for a short time, and bathe the integument with warm water, so as to induce relaxation of contracted arteries, which might otherwise cause secondary hæmorrhage. If, however, the antiseptic treatment be adopted, the stimulating influence of the lotion causes sufficient determination of blood to the part to render conspicuous any vessels that require ligature. In connection with the antiseptic system, torsion was revived a few years ago by Mr. Syme, who employed it sometimes even for arteries like the femoral. I have myself frequently twisted vessels of such magnitude, and the applicability of the method to them has been since further demonstrated, especially by Mr. Bryant and Mr. Cooper Forster.* But though torsion must always hold its place as a valuable means of arresting hæmorrhage, the antiseptic catgut ligature will, I believe, be found, as a general rule, more simple and efficient.

When the tourniquet is employed, it should be kept loose till the operation is about to commence, when it should be screwed up as rapidly as possible, to avoid an intermediate degree of constriction, which would check venous return without preventing arterial flow, and produce engorgement of the limb with blood which would be lost to the patient. For the last few years I have pursued with great advantage the practice of emptying the limb of venous blood by elevating it to the utmost, and having it pressed firmly from the extremity towards the trunk, just before the tourniquet is tightened. By this means the operation is rendered almost bloodless; and when a limb previously gorged with blood, from preternatural vascularity, is removed from an emaciated subject, the patient is left with actually a larger proportion of the vital fluid in his vessels than he had before the operation. In some cases it is wise to apply a bandage tightly from below upwards, while the patient is under chloroform, so as to force the blood out of the part to be removed, and save it to the circulation.

In cases in which the tourniquet is inapplicable, digital compression must be trusted to for preventing hæmorrhage during the operation. The strength of the assistant on whom this duty devolves is often early exhausted by unnecessary exertion; for the current through an artery lying over a bone, or some other resisting texture, is completely arrested by a very moderate amount of pressure directed exactly to the proper part.

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* See *Medical Times and Gazette*, March 11, 1871.

Amputations in the Upper Extremity.

The upper limb, independently of its smaller size, involving less shock to the system from the operation, is more favourably circumstanced for amputation than the lower, in consequence, apparently, of its possessing a better vascular supply and superior vital power. Thus, to take away the arm at the shoulder-joint is a much safer proceeding than to cut off a leg below the knee, even though a larger wound be inflicted, and a larger portion of the body removed, in the former case than in the latter.

The particular amputations in the upper extremity will be most conveniently considered in the order in which they occur from below upwards. The distal phalanges, though very liable to injury and disease, rarely require amputation; for the removal of crushed portions of bone in the former case, or exfoliation in the latter, will generally leave a useful end to the finger. If it be wished, the phalanx may be readily taken away by opening the joint across its dorsal aspect, and, after getting the knife round the base of the bone, forming a palmar flap, by cutting from within outwards. Or the palmar flap may be first cut by transfixion; and this being held up by an assistant, the operation is completed by cutting straight through the articulation. If the whole distal phalanx be crushed, amputation through the second phalanx will be best performed by cutting from without inwards two rounded lateral or antero-posterior flaps, and dividing the bone with pliers.

Removal of the entire finger is generally preferable to leaving the first phalanx by itself, which, besides being unseemly, would be a mere incumbrance, except in the index finger; and even there it is of service only in some few handicrafts. For the middle, or the ring finger, the operation is best performed according to the following definite rule. The adjoining fingers being held aside by an assistant, the surgeon cuts from the prominence of the knuckle in a straight line towards the middle of the web on one side; but, just before reaching the web, carries the knife inwards to the fold between the finger and the palm, and, after making a similar incision on the other side, accomplishes the disarticulation. The edges of the skin will be found to meet exactly on approximation of the adjoining fingers, which should be kept tied in that position, to avoid disturbing the process of union.

Remarkably little deformity results from this operation, so that removal of the head of the metacarpal bone for the sake of appearance is quite uncalled for. If, however, it is at any time necessary on other grounds to take away a portion of the metacarpal bone, this can be readily done by the same method, except that the incisions are made to start from the place on the back of the hand where the bone is to be divided by the cutting pliers.

The index finger may be removed in a similar manner, care being taken, in making the incision on the side next the thumb, to carry the knife from the point of the knuckle in a longitudinal direction to near the level of the web between the fingers, before sloping it off towards the palm, otherwise the flap will be insufficient to cover the raw surface. A preferable method, however, is to make dorsal and palmar flaps of rounded form, by cutting from the web between the fingers to a point on the opposite side of the articulation at a sufficiently high level to allow the end of the metacarpal bone to be taken off obliquely, with pliers, so as to get rid of what would cause an unseemly prominence. But if it be necessary to remove a considerable portion of the metacarpal bone, the former method, with the dorsal part of the incision extended upwards, will be the best.

Similar rules apply to the little finger, and, in cases requiring it, the whole metacarpal bone may be removed, by commencing the incision a little above the articulation with the *os unciforme*, so as to give space for dividing the ligaments after clearing the bone of the muscles which surround it.

Any portion of the thumb is valuable for opposition to the fingers, but, if necessary, the whole of it may be taken away by cutting in a curve, with the convexity downwards, from the web connecting it with the fore-finger to the opposite side of the joint, both on the dorsal and palmar aspects, raising the rounded flaps, and disarticulating. The whole metacarpal bone may be removed along with the thumb on a similar plan, by entering the knife a little above the articulation with the trapezium, and cutting first longitudinally, and then with a gentle curve to the web, on each side of the bone, then dissecting up the flaps, and dividing the ligaments of the joint.* This operation has been often performed for tumour of the metacarpal bone; but from a case published by Mr. Syme, it would appear that under such circumstances a useful thumb may be preserved by excising the bone affected.*

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* For removing the thumb or little finger with the metacarpal bone, other modes of operating, somewhat more rapid, but in other respects disadvantageous

The thumb alone or a single finger, being far more useful than any substitute, should always be retained if possible in cases of injury; an artificial hand being afterwards used, provided with a claw, against which the single digit left may be pressed so as to hold objects firmly.

Circumstances would occasionally admit of amputation at the wrist-joint, supposing this a desirable procedure. But of its two alleged advantages over amputation in the fore-arm, viz. the retention of pronation and supination, and a longer stump, the former, supposing such movements of an artificial limb to be desirable, would probably be often prevented by fibrous union between the radius and ulna, while the latter is found by the instrument-makers to encroach upon the space required for adapting the artificial limb. The operation, if desired, may be performed by cutting across the back of the wrist from one styloid process to the other, in a line presenting a slight concavity downwards, in accordance with the form of the articulation, opening the joint on its dorsal aspect, then shaping a rounded flap in the palm, raising it to the joint, and disarticulating. Another method is to cut the palmar flap from within outwards after disarticulation; but the prominence of the pisiform bone prevents this from being satisfactorily accomplished.

Amputation in the fore-arm may be performed by antero-posterior flaps. In front, where the muscles are in larger amount, transfixion may be adopted; but behind, the presence of the two bones prevents this, except near the wrist, where it may be effected, provided the soft parts have their natural laxity, by pinching up the skin, and passing the knife as close to the radius and ulna as possible, when, after the integument has fallen back to its usual position, the extremities of the wound will be placed so far forward that the knife can be introduced through them in forming the anterior flap. But it is probably always well to cut the dorsal flap from without inwards, and to

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even when applicable, were recommended before the introduction of anæsthesia. At present, it appears only necessary to mention such as are calculated to give the best results.

* Observations in *Clinical Surgery*, p. 38.

raise it so that it shall consist chiefly of integument, in order that redundancy of muscle and consequent tension may be avoided. The surgeon, standing on the (patient's) left side of the limb, and holding it with the dorsal surface towards him, enters the knife a little to the palmar side of the bone that is the further from him, and cuts through the skin and fat so as to shape a rounded dorsal flap, terminating the incision a little to the palmar side of the nearer bone, where he at once pushes in the point of the knife, so that it may pass in front of the bones and emerge at the place where the operation was commenced, and cuts a fleshy palmar flap from within outwards. He then dissects up the dorsal flap; and the soft parts being drawn back by an assistant, clears both bones thoroughly about three-quarters of an inch higher up, and applies the saw. The interosseous artery, which is apt to retract beside the unyielding interosseous membrane, must always be secured, as well as the radial and ulnar trunks; and if the median or ulnar nerve is exposed in the palmar flap, it should be shortened with scissors, to prevent the occurrence of painful symptoms as the stump heals. For preventing hæmorrhage during the operation, it is as well to apply a tourniquet to the arm, as the free arterial anastomosis in the upper limb may cause bleeding, in spite of effectual digital compression of the brachial vessel. In muscular subjects, the modified circular operation will afford better results.

There is no objection to amputation at the elbow-joint, in cases adapted for it. The most eligible plan is to cut a large anterior flap from within outwards, after transfixing the partially-extended limb in front of the joint, bearing in mind that the line of the articulation is oblique to the axis of the humerus, and is considerably further below the internal than the external condyle. The flap being then held up by an assistant, the points of transfixion are connected posteriorly by a semicircular stroke of the knife, which, besides dividing the integument, probably detaches the radius, and a few touches with the point of the instrument will sever the connections of the ulna. The assistant should keep the skin of the back of the arm drawn upwards during the operation.

Amputation of the arm presents a good example of the double-flap operation by transfixion. The point of the knife being entered at one side of the limb, avoiding the site of the brachial vessels and nerves, is pushed on in front of the bone; and then, by slightly raising the handle, is made to emerge at a place exactly opposite. The anterior flap is then cut with a brisk sawing movement of the instrument, which is first directed longitudinally for a short distance, and then turned gradually towards the surface, and brought out perpendicularly to the integument. The flap is now lightly raised by the assistant, without any traction, for this would interfere with transfixion behind the bone, which is effected through the extremities of the wound already made, and the posterior flap is cut like the anterior. The assistant now retracts the flaps firmly, when a circular sweep of the knife exposes the bone about an inch above the angle of union of the flaps, and another similar turn of the instrument prepares it for the application of the saw. The edges of the wound meet accurately when brought together, producing a symmetrically rounded stump. But when the muscles are largely developed, it is well to avoid the inconvenience occasioned by their redundancy, by cutting the flaps from without inwards, or by employing the modified circular method.

Amputation at the shoulder-joint is an operation which yields very satisfactory results, as was strikingly shown by the experience of the late Baron Larrey, who, during the wars of the first Napoleon, saved ninety out of a hundred cases, in spite of the very unfavourable circumstances of military practice.*

Of the various methods that have been proposed, that of Lisfranc is the most expeditious. The arm being raised so as to relax the deltoid, the point of a long-bladed knife is introduced about midway between the coracoid and acromion processes, and thrust round the outer side of the joint till it comes out within the posterior fold of the axilla (or, if the left limb be the subject of operation, the direction of transfixion is reversed), when a large muscular external flap is rapidly cut; and this being held up by an assistant, and the arm drawn downwards and forwards, the joint is opened by cutting firmly upon the head of the bone,† which is then raised from its socket so that the knife may be passed round it, and carried downwards along the inner surface of its neck and shaft, followed by the other hand of the assistant, which grasps the tissues that lie between the track of the instrument and the axilla, so as to prevent bleeding from the main artery, when it is divided in the completion of the short internal flap.

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* *Mémoire de Chirurgie militaire,* par le baron D. J. Larrey, tome iv. p. 434.

† Strictly speaking, this is Dupuytren's modification of the method of Lisfranc, who depressed the arm at the commencement of the operation, and opened the joint during the transfixion; but this was a less easy proceeding, though shorter by a few seconds in very expert hands.

This operation, however, is rarely available in practice. Its satisfactory performance requires the leverage of the humerus, which is generally broken in cases of injury demanding removal of the limb, in which also the parts necessary for the large external flap are often encroached on; and in tumour of the bone, which is the other affection that most frequently calls for amputation in this situation, transfixion becomes impossible.

On the other hand, Larrey's mode of operating, by lateral flaps of equal size, proved almost always applicable in his cases of gun-shot wound, while it was as secure against hæmorrhage as that of Lisfranc. Thrusting the point of a knife of moderate length down to the bone immediately below the acromion process, Larrey first made a longitudinal incision about two inches in length, from the extremity of which he cut in a curved line at each side of the limb to the fold of the axilla; then dissected up the muscular flaps so as to expose the articulation completely, a finger of an assistant being placed upon the divided circumflex artery; and, having severed the connections of the head of the humerus, passed the knife round it, and kept the instrument close to the inner side of the bone, till, turning the edge towards the surface, he last of all divided transversely the tissues intervening between the axillary folds, containing the artery, previously commanded by the hand of the assistant following the knife.*

This operation is improved by dividing the structures between the folds of the axilla obliquely, as part of the internal flap, the lower portion of which is reserved to be cut from within outwards, at the conclusion of the operation: the result being two precisely similar semilunar flaps, meeting above at the acromion and below at the posterior fold of the axilla, adapted for immediate union throughout their length, and presenting as small a wound as is consistent with an efficient covering.

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* During one period of his practice, he formed the lower parts of the flaps by transfixing from the end of the longitudinal incision to the borders of the axilla, and cutting from within outwards; but the method given in the text is that to which he ultimately gave the preference. See Larrey's *Clinique chirurgicale,* 1829, p. 563.

When the bone is broken near the joint, it will be found useful to adopt Mr. Syme's expedient of introducing the finger into a longitudinal wound in the capsule, for the purpose of drawing down the head of the bone so as to gain access to its attachments. In some cases of tumour it may be necessary to raise all the soft parts, including the axillary vessels, from without inwards; when hæmorrhage must be restrained by compression of the subclavian artery over the first rib, by the thumb of an assistant pressed down behind the collar-bone.

Sometimes it may be best to make a large superior flap, cut from without inwards, containing the whole width and chief length of the deltoid muscle; but circumstances will often arise in which no regular rule can be followed, and the parts that happen to be sound must be turned to the best advantage, according to the judgment of the operator. Even when a large raw surface is left, the granulating process will complete the cure, as is well illustrated by some of Larrey's cases, which terminated satisfactorily after extensive loss of the soft parts of the shoulder and removal of portions of the scapula.

Amputations in the Lower Extremity.

The distal phalanx of the great toe may be removed in the same way as that of a finger. When one of the smaller toes is in a condition requiring amputation at all, it should be taken away entirely, since any portion left would be likely to prove inconvenient from being tilted upwards. The operation is exactly similar to that for a finger; but it must be borne in mind that the articulation with the metatarsal bone, which is the starting-point for the incisions, is much further behind the web than the corresponding joint in the hand, in proportion to the size of the digit.

When the whole great toe is removed, or the little toe, the prominent part of the head of the metatarsal bone must be cut off by an oblique application of the bone-pliers, as it would prove inconvenient if left. The longitudinal part of the incision in the soft parts should be placed on the dorsum of the foot, to avoid the inconvenience that might arise from pressure on a scar at the lateral aspect. In amputating the great or little toe, together with the whole metatarsal bone, it is best to proceed as in the analogous operation for the little finger, the incision being commenced on the dorsum of the foot, about a quarter of an inch behind the articulation with the tarsus, and carried longitudinally to near the metatarso-phalangeal joint, where it bifurcates to embrace the root of the toe. The knife, which should be a strong one, is then applied with a short sawing action close to the metatarsal bone and its articulation with the toe, so as to clear them completely, and the ligamentous attachments of the base of the bone are lastly divided with the point of the instrument. In the case of the great toe, it is especially important to keep the knife well under command, and avoid thrusting its point deeply into the sole; for this, besides inflicting unnecessary punctures, may wound the plantar artery at a part difficult of access. This mode of removing the great or little toe and its metatarsal bone, though not so rapid as that of dissecting up a flap from the side of the foot, then cutting between the toe to be removed and the adjoining one, and disarticulating, has the great advantage of avoiding any scar in the sole.

If more metatarsal bones than one require removal, the incision must be begun in the same way, but made to include the roots of all the toes concerned, so as to form a dorsal and a plantar flap; and even in case of caries in the articulation between the tarsus and metatarsus at one side, a useful foot may be left after taking away the bones affected, by means of a similar incision commenced further back.

The separation of the whole metatarsus from the tarsus is an operation seldom called for; but it is evident, from the account given by the late Mr. Hey, of Leeds,* who introduced it, that it affords excellent results. When the state of the soft parts permits, the ends of the exposed tarsal bones should be covered with a long flap from the sole, turned up to unite with the dorsal integument, cut very short; so that the cicatrix, being on the upper part of the foot, may be out of the way both of pressure in walking and of contact with objects in front of it. In performing the operation, it must be remembered that the tarso-metatarsal articulations are not in a regular line, but that the base of the second metatarsal bone is locked between the first and third cuneiform bones, of which the former is the more prominent, and is connected laterally with the second metatarsal by a very strong interosseous ligament. To divide this ligament, Lisfranc adopted the plan of thrusting an amputating knife obliquely downwards and backwards between the first and second metatarsal bones into the substance of the sole, the tissues of which served as a fulcrum, supporting the point of the instrument, when its edge was urged forcibly between the bases of the bones by pushing the handle backwards. This, however, is a needlessly rough proceeding; for by pressing firmly back between the bases of the bones a strong and short knife, such as ought to be used for the rest of the operation, the ligament may be cut without difficulty; after which all the articulations are readily separated by scratching through the dorsal and other ligaments with the point of the knife, while the metatarsus is strongly depressed.

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* Hey's *Observations*, p. 555.

The secret of facility in the operation lies in hitting the line of the articulations; but this is readily enough done by finding first the joints of the first and fifth metatarsal bones, and bearing in mind that the others lie in a line between them, slightly convex forwards, interrupted by the recession of the second bone. The prominence of the base of the fifth metatarsal indicates the situation of its joint, and, if the parts be in a natural condition, the articulation of the first metatarsal with the first cuneiform can also be felt. Should inflammatory thickening obscure the position of the latter, it might be well to measure the distance of the corresponding joint from the internal malleolus on the sound foot; or assistance may be derived from the circumstance that the joint lies midway between the malleolus and the metatarso-phalangeal articulation.

These points having been precisely ascertained, the surgeon grasps the fore part of the sole with his left hand, placing the tip of the forefinger at one of the joints, and the thumb at the other, to mark their position, and cuts firmly across the dorsum of the foot in a line slightly convex forwards, a little anterior to the articulations, taking care that the incision commences and ends fairly in the sole. He then opens the joints of the first and fifth metatarsal bones, so as to ensure finding the line of the articulations afterwards, and next shapes a long plantar flap by an incision extending from the extremities of that already made along the sides of the foot and roots of the toes, dissects up the flap from the bones, and completes the disarticulation in the manner above described.

When the anterior part of the sole is unsound, a shorter plantar flap and a proportionally longer dorsal one may be made, as recommended by Sir Astley Cooper.*

Sometimes the proceeding may be greatly simplified by sawing through the metatarsal bones a little anterior to their bases, and so avoiding disarticulation altogether. This method would probably have another advantage, from making the stump of the foot longer, and therefore a more effectual lever for opposing the muscles which act upon the calcaneum through the tendo Achillis; for experience has shown that when the foot is much shortened, the heel is apt to be drawn up, so as to cause the end of the stump to point more and more towards the ground, producing lameness or entire inability to walk. This has been noticed especially after Chopart's amputation through the tarsus, which is consequently an undesirable operation, even in cases of injury; while in caries it is further objectionable, because the part of the tarsus left behind, though apparently sound at the time, may become affected with the same disease at a later period.

It it be wished, however, Chopart's operation may be performed on the same principle as Hey's, by making a very short dorsal flap, and a plantar one reaching to the balls of the toes, to cover the exposed anterior surfaces of the astragalus and os calcis. The articulation between them and the navicular and cuboid bones will be found in a line running across the foot, through a point midway between the external malleolus and the base of the fifth metatarsal bone.

In the amputation at the ankle devised by Mr. Syme, the bones of the leg are divided just above the bases of the malleoli; a covering for the osseous surfaces being provided from the integument of the heel; the result being a stump admirably fitted for bearing the weight of the body. At the same time, the parts likely to originate carious disease are completely got rid of; so that this operation is calculated to supersede entirely that of Chopart, besides taking the place of amputation of the leg in the majority of the cases formerly supposed to demand it.

The operation should be performed as follows. Provision being made against hæmorrhage from the anterior and posterior tibial arteries, by the pressure of the thumb and finger of an assistant, placed respectively on the middle of the fore part of the limb and behind the tibia, about two inches above the joint, or by a tourniquet applied in the same situation, and the foot being held at right angles to the leg, the surgeon puts his left hand behind the heel, with the finger and thumb on the places where the incisions are to commence and terminate ; these being the tip of the external malleolus and the point exactly opposite on the inner side, i.e. not at the tip of the internal malleolus, but considerably below and behind it. With a knife, short and strong both in blade and handle, he now cuts down to the bone across the sole, from one of these points to the other, in a plane either vertical or sloping slightly towards the heel when that part is unusually prominent; and then, extending the foot, joins the horns of this incision by another running as straight as possible across the front of the ankle. He next dissects up the posterior flap from the os calcis, keeping the edge of the knife close to the bone with the guidance of the left thumb-nail, till the point of the calcaneum is fairly turned, when he proceeds to open the joint in front, divides each lateral ligament with a stroke of the knife applied between the malleolus and astragalus, and completes the removal of the foot by severing the tendo Achillis. He then prepares the bones of the leg for the application of the saw; taking care, when cutting behind the tibia, to keep close to its surface, from which the posterior tibial artery is separated only by a little loose cellular tissue; and lastly, he takes off the malleoli along with a slice of the intervening part of the tibia, sawing perpendicularly to the axis of the limb.

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* *Surgical Lectures,* edited by Tyrrell, vol. ii. p. 432.

It is a common mistake to make the inner end of the incision at the internal malleolus, instead of opposite the extremity of the outer one. This has two bad effects: it renders the flap unsymmetrical, and, what is far worse, it makes it unnecessarily long, and thus introduces an element of difficulty and risk into an easy and safe operation. For when the incision is carried forwards to the hollow of the foot, it becomes a most troublesome task to turn back the integument over the prominence of the heel; and the knife being thrust the operator knows not where, the subcutaneous tissue on which the skin depends for its nourishment is punctured and scored, and perhaps the point of the instrument appears occasionally through the skin itself, while the flap is subjected to violent wrenching in the effort to draw it back over the bony projection. Under such a combination of unfavourable circumstances, it is but natural that it should slough.

On the other hand, when the flap has been made as above directed, in accordance with the latest recommendations of the author of the operation,* it applies itself with perfect uniformity to the surface it is designed to cover, and has no disposition to shift to one side in the after progress of the case; and every stroke of the knife by which it is raised being made under the eye of the surgeon, without any forcicle traction, it is as little liable to slough as any other portion of integument with an equally broad base and an equally rich vascular supply. Even the integrity of the posterior tibial artery, though desirable, is by no means essential, provided the rest of the subcutaneous tissue has been left uninjured. Many persons, in discussing the merits of this operation, seem to assume as an axiom that sloughing of the flap must occasionally take place; but I am persuaded from very extensive experience that, if the skin of the heel be sound, such an occurrence will always be the fault of the surgeon.

Hence the various modifications of the original method that have been suggested, though commonly discussed chiefly with reference to a fear of sloughing, must be judged of entirely on other grounds. Thus the plan introduced by the late Dr. Richard Mackenzie, of Edinburgh, of making the base of the flap at the inner side, that it may have a more free supply of blood from the posterior tibial artery, is not to be regarded as a substitute for the simpler method of a posterior flap; yet it proves useful in case of unsoundness of the integument on the outer side of the heel; and it is probable that an external flap might be made with equal advantage if the internal aspect of the limb were affected.

The operation of Professor Pirogoff, of Petersburg, in which the posterior part of the os calcis is sawn off and turned up as part of the flap to unite with the cut end of the tibia, has the disadvantage in cases of caries that it entails a risk of recurrence of disease in the portion of the calcaneum remaining. It is also more complicated than Mr. Syme's method, from the necessity of accurate adjustment of the osseous surfaces, with a view to their union; while the increased length of the stump which it produces is rather objectionable than otherwise; for, with the original operation, the space afforded for the artificial foot is not more than the maker finds convenient.

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* See Mr. Syme's Clinical Lectures in the *Lancet*, 1854.

When the ankle is affected with caries, the vertical articular surfaces by which the joint is continued upwards between the tibia and fibula should be removed with cutting pliers, to guard against recurrence of disease in that situation.

In cases which do not admit of Mr. Syme's operation, amputation immediately above the ankle should be performed if possible, in preference to that at 'the seat of election,' a little below the knee; for although the use of the knee-joint may be retained even with a very short stump, the longer one gives greater command over the artificial limb, and the operation involves less risk to life.

Different methods may here be employed. One mode is to make a short semilunar anterior flap cut from without inwards, and a larger posterior one formed by transfixing behind the bones and cutting downwards and outwards, the saw being applied a little above the bases of the flaps; or antero-posterior skin-flaps of equal length may be made, and the bones divided somewhat higher up. Or again, the modified circular operation* is applicable in this situation.

But the method by longer anterior flap is greatly to be preferred to any other, on account of the excellent covering it affords, with the cicatrix out of the way of pressure, enabling the stump to sustain the whole or a considerable part of the weight of the body on its extremity. The principles on which the operation should be performed have been already fully discussed in former pages,† but a modification of the plan there indicated is called for on account of the difficulty of retracting the soft parts from the bones. This arises especially from the intimate attachment of the muscles to the fibula; but if these are divided through an extension upwards of the outer longitudinal incision, no difficulty is experienced, unless the tissues are condensed by inflammatory thickening, in effecting retraction of the remaining soft parts from the tibia without dividing the skin at the inner side to a higher level than the typical operation demands. Another point requiring special attention in the leg, as compared with the thigh, is the raising of the anterior flap. The anterior tibial artery, on which the flap depends for its nutrition, lies close to the interosseous membrane, and would be very liable to be punctured during the dissection if we did not follow Mr. Teale's advice in conducting it. He pointed out that in consequence of the looseness of the cellular connections of the interosseous membrane, there is no difficulty in separating the parts in front from its surface with the finger tip, while dividing with the knife the attachments of the muscles to the bones.* In this way, the vessel is secured from any chance of injury.

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* See p. 601.

† See p. 602 *et seq.*

Immediately above the ankle the operation is performed as follows. The diameter of the limb having been ascertained by spanning it, a straight longitudinal incision of that length is made at the inner side of the leg, and on the outer aspect another similar incision directly over the fibula and extending about an inch higher up. The lower ends of these incisions are connected by cutting across the front of the limb in a direction transverse in the main, but rounded off where it joins the lateral lines. The knife is next carried round the back of the limb to the bones from the upper end of the internal incision to a point exactly opposite on the outer side, which will be about an inch below the upper end of that incision; the instrument being carried in a line slightly convex downwards, so as to form a very short posterior flap. The anterior flap is then raised in the manner above mentioned, including everything in front of the bones and interosseous membrane; after which the tibia and fibula are cleared as high as the level of the upper end of the outer incision, the finger tip being still used in detaching the parts anterior to the interosseous membrane.

In order to avoid splintering the fibula, it is best to saw both bones at the same time, and to finish the fibula before the tibia. The sharp angle of the spine of the tibia, being apt to cause ulceration of the skin over it, should be removed; and the most convenient way of doing this is to commence with sawing obliquely for a short distance from a point about half an inch above the place where the bones are to be divided transversely. Supposing the antiseptic treatment employed, the cutaneous margins of the flaps may be stitched very closely, except at the upper end of the outer incision which is left open for the drain, and serves admirably for the purpose, as it leads directly from the cut surfaces of the bones, and is dependent in position from the circumstance that the limb reposes on its outer side. Accurate stitching is desirable elsewhere, in consequence of the disproportion of the sizes of the two flaps, which however, is diminished by making a short posterior flap as advised.

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* See *Medical Times and Gazette*, July 6, 1861.

In amputating through the calf on the same principle, the operation is similar, except that, for reasons before discussed,* the anterior flap need not be longer than two-thirds of the diameter of the limb; but, to compensate for its diminution, the posterior flap must be made at least half as long as the anterior, by carrying the knife round the back of the limb at an angle of forty-five degrees through the integuments, and dissecting them up to the level of the upper end of the inner incision, before cutting towards the bones, so as to get rid of the heavy and contractile mass of the sural muscles.

The old flap operation is still employed in the calf by many surgeons, being very readily accomplished by drawing the knife in a segment of a circle across the front of the leg from one bone to the other, transfixing behind them, and cutting first downwards and then gradually outwards, next dissecting up the anterior flap of integument, and clearing and dividing the bones at the level of its base. But it is, as we have seen,† a most undesirable proceeding, on account of the bulk of the muscular mass from the calf turned up to cover the ends of the bones. Professor Spence, of Edinburgh, gets rid of this objection by shaving off a considerable portion from the face of the posterior flap after forming it. But though this is undoubtedly a great improvement, it cannot give to the operation the advantages of the method by longer anterior flap.

When there is not enough sound integument to admit of the latter method, the modified circular operation of Mr. Syme ‡ proves highly valuable, enabling us to form out of the smallest amount of materials a short stump, which is preferable to any that result from operating higher up in the limb, the patient either retaining the use of the joint or resting his weight with great security and comfort upon the bent knee.

For restraining hæmorrhage during amputation of the leg, the tourniquet should be applied round a roller placed between the hamstrings.

The great merits of Mr. Carden's amputation through the condyles of the femur have been already fully discussed.§ I cannot but agree with him that the patella should always be removed. In cases of injury it may seem a tempting thing to leave it, sawing off its articular surface, that it may unite with the divided end of the femur; but having tried this plan before Mr. Carden published, I have found that while it may result in an admirable stump, it is sometimes attended with serious inconvenience, from the patella being tilted up from its proper position by the action of the quadriceps extensor. Besides this, the presence of the patella in the covering for the end of the femur interferes with its adequacy, and makes it needful to borrow more integument from the front of the leg than is otherwise requisite. And as regards the ultimate result, when the sawn extremity of the femur has been rounded off by ossific deposit, it proves little, if at all, inferior to the patella for bearing the weight of the body. The only objection to Carden's operation, as described by him,* is the occasional occurrence of more or less sloughing of the long anterior flap of skin, in spite of faultless operating. It is plain that the risk of sloughing would be diminished if the flap could be made shorter by not carrying the horns of the incision by which it is formed so high up the limb; and on making experiments on the dead body some years ago, to ascertain to what extent this could be done without disadvantage, I found that it is by no means difficult, when the parts are in their natural condition, to accomplish the operation without making any anterior flap at all, the integuments being divided transversely, as in the old circular method, at the level of the lower end of Mr. Carden's flap. I also found it advantageous to form a short posterior skin-flap, both for the sake of coaptation of the cutaneous margins without puckering, and as a useful addition to the covering for the end of the stump.

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* See p. 608. † See p. 600. ‡ See p. 601. § See p. 606.

With this modification, the operation is performed as follows. The surgeon first cuts transversely across the front of the limb from side to side at the level of the anterior tuberosity of the tibia, and joins the horns of this incision posteriorly by carrying the knife at an angle of forty-five degrees to the axis of the leg through the skin and fat. The limb being elevated, he dissects up the posterior skin-flap, and then proceeds to raise the ring of integument as in a circular operation, taking due care to avoid scoring the subcutaneous tissue; and, dividing the hamstrings as soon as they are exposed, and bending the knee, he finds no difficulty in exposing the upper border of the patella. He then sinks his knife through the insertion of the quadriceps extensor, and having cleared the bone immediately above the articular cartilage and holding the limb horizontal, he applies the saw vertically and at the same time transversely to the axis of the limb (not of the bone), so as to ensure a horizontal surface for the patient to rest on. The popliteal artery is then secured, and any articular or other small branches that may require it.

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* See p. 606.

When the soft parts are thickened and condensed by inflammation, the integuments cannot well be reflected above the patella with such incisions of the skin. But the difficulty may be got over by cutting into the joint as soon as the ligamentum patellæ is exposed, and at once removing the leg by dividing the ligaments and hamstrings; after which the soft parts can be retracted from the femur sufficiently to permit the application of the saw. The arteries having then been secured, the patella is dissected out at leisure.

As thus performed, Carden's operation takes a little more time and pains than when the integument is divided in the form of an anterior flap; but these are well rewarded by the ample covering for the bone, the small external wound, and the perfect security against sloughing.

Some surgeons speak highly of amputation through the knee leaving the articular portion of the femur and the patella, a covering being provided by forming a large anterior and short posterior skin flap from the leg, the result being that the patient rests his weight upon the broad rounded end of the bone while the patella is drawn up by the quadriceps to occupy the hollow between the condyles in front.* There can hardly, I think, be two opinions as to the superiority of Carden's method to this procedure for carious disease of the knee-joint, and in cases of injury, when the integuments are sound as far as five inches below the patella, which is the length of the long anterior flap according to the method hitherto recommended,† a satisfactory though very short stump may be made below the knee. But from my experience with Carden's operation I feel sure that the amputation through the knee may be much improved by dividing the integument in the circular fashion, slightly modified to permit neat adjustment of the cutaneous margins, in which case it would not only be freed from the risk of partial sloughing of the anterior flap which is admitted by its advocates,* but, the posterior integument being made to take a larger share in forming the covering, it would not be needful to go so far down the limb in front, and thus the operation would become available for cases of injury reaching too high in the limb to permit amputation below the knee. And in order to ensure complete adequacy of the covering, the saw might be carried through the middle of the articular end of the femur so as to flatten it without interfering with its breadth, and thus in all probability improve rather than impair the fitness of the end of the stump for bearing the weight of the body. On this matter, however, I cannot as yet speak from personal experience.

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* See especially a paper on amputation at the knee-joint, by Mr. Pollock, *Medico-Chirurgical Transactions*, 1870.

† See Mr. Pollock, *ibidem*.

In amputation of the thigh, if we except cases in which the soft parts are affected at one side only, where a covering may be advantageously provided from the sound side, the flaps should always be antero-posterior, because, the flexor muscles being no longer counteracted by the weight of the limb, the bone tends to become tilted forwards, so that its extremity would be apt to show itself in the anterior angle of lateral flaps.

In the lower half of the thigh, the method by longer anterior flap, on the principles before considered,† will be found easy of execution and excellent in results. Two straight incisions are made through the skin and fat along the lateral aspects of the limb, parallel to its anterior surface, and equal in length to two-thirds of its diameter, and their inferior extremities are connected in front by a straight transverse cut, curved upwards near its ends to join the longitudinal ones, so as to shape out a moderately long rectangular flap with rounded angles, if we may so speak. The knife is then passed round the back of the thigh at an angle of forty-five degrees to its axis, marking out a short posterior skin-flap, which is at once dissected up, the limb being well elevated by an assistant. The anterior flap is next raised so as to contain a moderate amount of muscle, and the soft parts being well retracted, the knife is swept circularly through the muscles, so as to expose the bone for the application of the saw about two inches above the angle of union of the flaps.

The incisions should always be made as far down in the limb as the state of the soft parts permits, so as to increase the length of the stump and diminish the danger of the operation;

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* See Mr. Pollock, *ibidem*.

† See p. 607.

and the skin over the patella, if available, will be employed with great advantage as part of the anterior flap.

The tourniquet must be applied as high as possible in the thigh, and if the constricting band is found to interfere with the due retraction of the soft parts, it is best to saw the bone in the first instance where it is easily reached, and after securing the vessels and removing the tourniquet, expose the bone at the requisite level, and saw off an additional portion, held steady with a pair of strong forceps. In this way the great benefits of the tourniquet, in rendering the operation almost bloodless, may be secured for amputations at a level in the limb at which it would otherwise be inadmissible.

When digital compression is resorted to, the hands should grasp as much of the circumference of the limb as possible, while the thumbs are placed over the vessel, as it lies on the pelvis, midway between the symphysis pubis and the iliac spine.

Even in the upper part of the thigh, although the object of having a stump capable of bearing weight upon its extremity is no longer to be considered, the operation above described will be found to yield better results than that by transfixion, by avoiding the redundancy of muscle which is the great defect of the latter method. Nor need this plan involve greater loss of blood. For the posterior flap, being only cutaneous, can be raised without material bleeding; and the anterior flap, after being shaped by carrying the knife through the skin and fat, may be completed by transfixion, while comparatively little retraction of the soft parts is required, in consequence of the shortcut muscles having little tendency to cause protrusion of the bone.

Amputation at the hip-joint, though a most formidable proceeding, has, nevertheless, been attended with a sufficient amount of success to render it justifiable in circumstances that would otherwise be desperate.

The easiest and most rapid method is to form a large anterior flap by transfixion, disarticulate, and cut a short posterior flap, also from within outwards. The thigh being somewhat flexed, to relax the soft parts of the front of the limb, the point of a knife with a blade about a foot long is entered midway between the anterior-superior spinous process of the ilium and the great trochanter, supposing the left side operated on, and passed in front of the bone till it emerges near the tuberosity of the ischium, or in the opposite direction if it be the right limb.

The knife is then carried longitudinally with a rapid sawing movement, followed by the fingers of one hand of an assistant, which are introduced into the wound so as to compress the femoral artery securely between them and the thumb, previously placed over it in the groin, his other hand being employed to lift up the large anterior flap as soon as it is completed. The limb being now extended and abducted, the surgeon opens the capsule of the joint by cutting firmly upon the head of the bone; and as this starts from its socket, he divides the round ligament and the posterior part of the capsule; and lastly, the thigh having been adducted, to draw the trochanter down out of the way of the knife, he completes the severance of the limb by cutting downwards and backwards through the muscular mass at the back of the thigh.

Attention is now at once directed to the bleeding vessels of the posterior flap, fed by the internal iliac, which are covered in the first instance with a folded cloth, or, what is better, by the tips of the fingers of an assistant; and when they have been tied, the femoral trunk and any of its branches which may require it are secured in the anterior flap.

When the state of the parts does not admit of a long anterior flap, the posterior one may be lengthened without increasing the hæmorrhage, by shaping it at the commencement of the operation by an incision extending only through the skin and fat, and dissecting up the integument to the part where the muscles can be conveniently divided from within outwards, after the shorter anterior flap has been formed and disarticulation effected in the usual way.

But cases not unfrequently occur in which the antero-posterior method by transfixion is altogether inapplicable; as when tumour affects the upper part of the bone, or when the soft parts are destroyed by injury extending high up at one side. The integuments must then be turned to account to form a covering, according to the best judgment of the surgeon, by operations necessarily more or less protracted. Under such circumstances, and indeed in all cases of amputation at the hip-joint, great advantage will be derived from the use of the aortic tourniquet, an instrument first used for this purpose by Professor Pancoast, of Philadelphia, in 1860,* and since employed sufficiently often to prove alike its safety and efficiency. By its means, the flow of blood through all the branches of the internal as well as external iliac artery being completely arrested, amputation at the hip-joint is divested of the risk of serious hæmorrhage, which used to be its most formidable danger. In the form suggested by myself, in which alone I have seen it, the instrument consists of a bar of steel bent in a nearly semicircular form, to embrace the side of the body, with one end expanded and covered with soft material for application to the back, while the other end receives a screw, which presses down a pad somewhat broader than the diameter of the aorta; the object being to compress the artery as it lies on the body of the fourth lumbar vertebra, without obstructing more than necessary the return flow through the vena cava. It is to be remembered that no great force is required to arrest the arterial current, provided the pressure be accurately applied, while mischief might be done by using the screw with needless violence. The only way to ensure accuracy of adjustment of the tourniquet is to feel for the pulsation of the aorta and screw the pad down upon the pulsating part: for the umbilicus is a most untrustworthy guide, and the vessel is by no means constantly to the left of the middle line, as described in anatomical works, but, happily for its satisfactory compression, appears to be as frequently mesial, where the body of the vertebra is practically flat, while it is occasionally found a little to the right.* The iliac crests are the best guide to the level at which the clamp should be fixed, the bifurcation of the aorta being nearly on a line with their highest parts, so that the instrument should be put on a little above them. When the centre of the aorta is as much as half an inch to the left of the middle line, which is a rare occurrence, the screw of the tourniquet comes to deviate laterally from the vertical direction, as the patient lies, by an angle of about thirteen degrees, in order to be perpendicular to the convex body of the vertebra at the part; but the instrument above described can be readily made to assume such a position, especially if the posterior pad be convex. I have found it advantageous to interpose a small round sponge between the anterior pad and the abdomen, as it accommodates itself well to the parts to be compressed. While the pad is being screwed down, an assistant, with his finger on the femoral artery at the groin, marks the time when its pulsation ceases. Since it is impossible entirely to avoid interference with the vena cava, with a consequent tendency to venous engorgement, the limb should always be emptied of its blood by freely elevating it and bandaging firmly from the toes upwards immediately before the performance of the operation.

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* See the *American Journal of the Medical Sciences*, July 1866. In the former edition of this Article, written in 1861, the aortic tourniquet was alluded to as if originating with myself. It was only comparatively lately that I became aware that I had been anticipated by Professor Pancoast.

JOSEPH LISTER.

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* Out of thirty bodies examined, seventeen by myself, and thirteen by my friend Dr. Barbour, then resident physician to one of the Glasgow workhouses, and afterwards of the London Fever Hospital, the aorta was either absolutely or almost absolutely mesial in fifteen, while in thirteen it deviated more or less to the left, and in two was slightly to the right. In order to make the observations accurately, three long needles were pushed down vertically, and therefore parallel to each other, one at each side of the body of the vertebra, and one through the centre of the collapsed aorta into the vertebra beneath. The distance of the middle needle from each of the lateral ones was read off on a measure applied transversely, half the difference giving the deviation of the artery from the middle line.

ON EXCISION OF BONES AND JOINTS.

Excisions in general.

THE operations which are to be described in the sequel are all of modern introduction into practice; for although scattered passages are found in the writings of the medical authors of antiquity which have been held to prove that they were acquainted with the possibility of dissecting out diseased or injured bones, it must be allowed that such passages are in many respects dubious; and it is at any rate certain, that operations of this kind were very rare in olden times; that no rules were laid down for them in ancient Surgery; and that they had altogether passed out of notice before the revival of Surgery as an art founded on rational principles.* When this had once happened, an attempt to preserve a limb by removing only the diseased portions of bone was so reasonable, that it was sure to be made; nor will it now be denied by anyone, that a large amount of success has attended that attempt.†

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* I have not space here to trace the history of excisions from the introduction of the operation by Park and the Moreaus; but would refer the reader for this, and many other points connected with the history and statistics of excision, to a very valuable essay on *The Excision of Joints*, by Richard M. Hodges, M.D., Boston, U.S., 1861.

† Of the success which may attend the practice of excision in properly selected cases, there are some striking instances in the *Med. Chir. Trans.* Thus, in vol lii. of that series, Dr. Humphry reports that he excised the knee in 45 patients, of whom 1 was under treatment, 33 recovered, 2 died, and 9 underwent amputation, of whom 5 recovered and 4 died. Many of these cases were in adults, one being as old as 47. In the same volume Mr. H. Lee contributes a table of 22 cases of excisions of the large joints with only two deaths, both after excision of the knee. Here, however, there was only one patient who recovered from excision of the hip or knee beyond the period of childhood. In vol. liii. Mr. Gant gives an account of 20 cases of various excisions without a death; 9 of these were excisions of the knee —the eldest 33 years of age—3 underwent amputation; 6 were excisions of the

I propose here, as well as my limits will permit, to treat, *first*, of the general indications for excision of entire bones or of their articular ends, as opposed to treatment without any operation, or to orthopædic measures, or to amputation; and, *secondly*, to describe the operations in use for removing certain entire bones, and the joints which are accessible to such treatment.

In considering the question between excision and what may be termed the expectant treatment, it may be laid down as a general rule, that a large or important joint ought not to be excised while any reasonable prospect exists of a cure without operation; but when bones which are of no great size, and removable by a moderate operation, are extensively diseased, the surgeon may very reasonably propose to cut short the disease by excising the entire bone, while yet he may allow that recovery is not hopeless should the patient's circumstances allow of his obtaining prolonged and judicious treatment; for the result of prolonged treatment is always doubtful, and the most fortunate termination which could be obtained by many months or perhaps years of care will leave the patient's condition little better than the operation from which he will, in all probability, recover in a few weeks.* I have had very frequent opportunities of noting the success of operations for the removal of bones of the tarsus and metatarsus, and the superiority of such treatment to that of waiting for a cure—especially in children, whose restlessness renders confinement less likely to be borne. In the hand and wrist, however, such operations are far less applicable.

M. Sédillot is the chief advocate of an operation to which he has given the name of 'l'évidement des os,' and which is really nothing else than carrying the usual operation of gouging farther than is commonly done, so as to scrape away the whole interior of the bone, and leave behind (as is presumed) nothing except the periosteum lined by a layer of bone. It must also be presumed that the periosteum and bone so left behind are healthy. I cannot but think that these presumptions are likely to be frequently falsified in practice. If the

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hip—the eldest 26 years of age; the other five were cases of excision of the elbow—the eldest 50 years of age. Re-excision was performed in one of the knee and one of the elbow.

* I would also refer the reader, on this head, to Mr. Johnstone's observations in the essay on DISEASES OF THE JOINTS, vol. iv. p. 50.

bone were so extensively diseased as to justify the removal of its entire thickness, I believe either that the periosteum would be easily separable from it, and the whole bone could be removed by subperiosteal resection (as will be detailed further on under the head of excision of the shaft of the tibia), or that the periosteum would also be extensively diseased, in which case the better course would be to excise the whole bone without sparing the periosteum, or to amputate, according to circumstances.

Connected with this part of the subject is the question of the total or partial extirpation of the bone. If the function of the diseased bone be not very important, it is always better to remove the whole of it, since it is often hardly possible in an operation to judge of the real condition of the bone; and if the entire thickness of the bone has to be taken away for any considerable extent, it is very doubtful whether the parts left behind will be of any use; while if the whole be removed, and no osseous tissue be left exposed in the wound, the latter will heal much more readily and probably with less danger of systemic infection.

But the question which far more often perplexes the surgeon is not that between excision and the expectant treatment (except perhaps in the case of the hip), but between excision and amputation. This is so extensive a subject, and so much dependent on the circumstances of each individual case, that I can hardly hope to do more than indicate to the reader the leading considerations which apply to it. They are drawn from numerous circumstances, which may be thus grouped: 1. the situation and functions of the bone or joint to be excised; 2. the state of the patient as to general health, constitutional affection, and age; 3. the nature and extent of the disease; 4. various extraneous circumstances. I will proceed, as briefly as possible, to point out the most common indications for one operation or the other under each of these heads.

1. As to the situation and functions of the bone or joint affected. In the upper extremity, almost any excision which affords a prospect of preserving to the patient the motion of the elbow, of the hand, of the fingers, or perhaps even of the thumb only, is to be preferred to amputation, even although the patient may not recover useful motion in the joint operated on, whether it be the shoulder, or the elbow, or the wrist. There is, however, a limit to the application of this rule, since a limb which swings useless, like a flail, may prove more of an annoy-

ance than an advantage. In the hip the question of amputation for disease does not occur under ordinary circumstances, in any case where excision is possible:* and in gunshot injuries, which are almost the only cases in which the operations are pitted against each other, the nearly uniform fatality of primary amputation at the hip, in modern military surgery, gives the surgeon a decided leaning to excision. In the knee the question is more difficult, and the advantages of the stiff limb, left after even the most successful excision, over the artificial substitute (especially in the case of a wealthy person, who can afford to purchase the ingenious artificial limbs now manufactured), are not so great as to balance, in the minds of some surgeons, the increased danger to life which (as I fear we cannot help admitting) the operation entails, combined with the risk of failure and of the necessity for consecutive amputation. But excision of the knee is now generally adopted in patients otherwise healthy, when the disease is only of limited extent, so as to be curable by the removal of thin slices of the affected bones. In injuries of the knee, excision has not as yet been much practised, nor has the experience obtained of it been very satisfactory: the injuries to the knee that demand operation in civil practice are generally too extensive for excision, and other reasons usually preclude it in military surgery; but in limited injuries it will occasionally be attempted in both civil and military practice. Below the knee, the excision of large portions of the bones of the leg seems much practised in Germany; but chiefly in necrosis, of which we shall have to speak presently. The excision of the ankle has occasionally yielded satisfactory results in the hands of Mr. Hancock † and other operators, amongst whom I may reckon myself; but amputation at the ankle-joint is so much less severe an operation, and so much more sure of success, that even now few surgeons care to attempt excision. In cases of injury, the comminuted portions of bone may occasionally be removed, and a useful foot preserved; but no rules can be laid down on this point. In the tarsus, the removal of the os calcis when much diseased or extensively injured is a very successful operation, and one which should always be preferred to amputation. The astragalus, when dislocated, has been excised without much impairment to the usefulness of the foot, and I have on several occasions removed the entire bone in chronic disease with a very good result. The bones of the front of the tarsus are far less favourably situated for excision, since they are all enveloped in the folds of a common synovial membrane, and therefore are prone to participate in each other's diseases; but still, in the cases, which are so common, of caries attacking the cuneiform or cuboid bones, an attempt ought always to be made to save the foot, by removing the bones affected, whenever the disease has not spread too far. When one or two metatarsal bones are extensively diseased, they should be dissected out, the toes being removed at the same time, if the operator thinks fit. I have only had occasion to practise this on the first metatarsal bone, which I have several times removed with very good results, leaving the great toe, which will derive so much support from the next toe as to become extremely useful.

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* In rare cases amputation at the hip-joint is, I think, justifiable, when the disease extends too far for excision or the knee is simultaneously affected. The point will be discussed further on.

† Barwell *On the Joints*, p. 463.

2. With respect to the state of the patient, it may be said, in general terms, that excision of large joints is only to be recommended for patients in good health, not worn out by previous disease or confinement, nor deeply affected with constitutional taint (rickets, struma,* rheumatism, or syphilis); nor should such an operation be practised in the joints of the lower extremity on patients past the middle period of life. In the very early period also, many risks may be run with a view of avoiding excision and preserving the limb entirely; and, after the failure of such attempts, the case has usually passed beyond the reach of excision, when amputation becomes necessary. So that excisions are almost exclusively practised in childhood, youth, and early manhood.

3. As to the disease—excision is never to be recommended for the removal of malignant diseases of the joint-ends or other parts of the bone. It is true that such operations have been practised by very good surgeons; but they must be regarded as experimental proceedings, justifiable in the early period of the operation, but contra-indicated by more extensive experience. Nor should excision be practised on account of acute abscess of the knee-joint, and only with much caution in acute diseases of any joint. It is much better to endeavour by free incisions and appropriate treatment to support the patient

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* I have, however, removed the elbow-joint in strumous children with very good results, though there has been extensive strumous disease elsewhere.

through this stage, with a view of removing the joint (if the extent of the disease renders it practicable) at a later period; but should the patient's health be giving way under the irritation of acute abscess, amputation is indicated in the knee and ankle, and the prospects of excision in other joints are very much less favourable than in chronic cases. The most appropriate cases for the excision of joints are those of chronic disease of all the tissues ('white swelling'), in which the bones are probably not affected to any great depth—a disease which may be due to a strumous taint, but in which the constitutional affection has subsided or is no longer active. In chronic abscess of bone occurring near the articular surface and making its way into the joint, excision may be practised with every chance of success, provided the abscess is not too far from the joint-surface. Necrosis of the articular surface only is another favourable condition for excision; but in many cases the mere removal of the dead bone will suffice. For excision of entire bones, necrosis of their shafts is the most favourable condition, since the periosteal sheath may be relied on to reproduce the bone to a sufficient extent to restore the functions of the member. In such conditions whole bones of the upper and even of the lower extremity have been removed, without any detriment to its ultimate usefulness. In extensive caries, on the other hand, amputation is clearly indicated in the lower extremity; while even in the shoulder, elbow, and wrist, though an attempt to preserve the limb when the carious disease extends considerably beyond the epiphysial ends may not be unjustifiable, it must be allowed to be of very doubtful benefit.

4. The extraneous circumstances which may decide the surgeon to perform amputation, in a case otherwise favourable for excision, refer principally to the lower extremity, and depend on the facilities for after treatment. Excisions in the lower limb require, in order to have a fair prospect of success, uninterrupted care and unbroken repose, in appropriate position, from the moment of the operation, for many weeks or even months. Hence the great rarity of the performance of excision of the knee in military practice, and the bad success which has attended it. Or the patient's irritable habits and impatience of confinement may occasionally lead to the preference of amputation.

General Observations on the Operations of Excision.

In the resection of any large joint, except the hip and the shoulder, I prefer in ordinary cases to remove the whole articulating surface. Partial excisions, though they appear to succeed well enough in the two great ball-and-socket joints, are repudiated in the case of the large ginglymoid joints by most surgeons of experience;* and even in the hip and shoulder many prefer total excision. Hence it is necessary, in the first place, to divide the soft parts freely, in order to be able to turn the ends of the bones out of the wound, and apply the saw above the articular surface. The removal of the diseased bone piecemeal, by scooping out the joint-ends, is a very inferior practice, for it is difficult to judge of the condition of the part left behind, and the union is liable to be very irregular, and will probably be delayed by the separation of numerous small nodules broken away from the bone, but not removed. Whereas, if the end of the bone be well exposed, and a clean section made with the saw, the condition of the bone left behind can be ascertained with almost entire certainty, and the parts are placed in the most favourable circumstances for union. In the upper extremity, where freedom of motion after the operation is sought for, it is desirable to prevent too extensive cicatrisation, and especially the adherence of the cicatrix to the bones. Therefore, when the operation is completed, the parts should be carefully readjusted; those portions of the wound in which it is wished to secure speedy union without puckering should be brought together with silver sutures, while free exit for the matter in other parts of the incision is allowed. It must not be forgotten that excisions are not, under ordinary circumstances, performed until the joint has become disintegrated by chronic disease, so that both the tissues around the joint and those which enter into its composition, vary very much from their natural state. Around the joint, the thickening produced by old inflammation, and the burrowing of abscesses and sinuses, tend to obscure the natural relations and appearances of the parts; while in the joint, old dislocation and partial ankylosis may render what would otherwise be an easy operation inordinately difficult, and may even make it almost impossible to recognise the parts exposed. Then, again, the contraction of the tendons, which sometimes accompanies long-continued disease of the joints, may have reached such a point that the limb cannot be placed in the proper position without the aid of tenotomy. In consequence of all these circumstances, the knife must be kept close to the bones when they are reached, in order to avoid any part which it may be desirable to spare, but which the morbid condition of the tissues prevents the operator from seeing; and the surgeon must be prepared to vary his proceeding slightly with the varying condition of the articulating ends of the bones. The operator should be careful not to confound with caries that roughening of the surface of a bone which is produced by healthy periosteal inflammation, spreading from the diseased joint, and often extending to a considerable distance on all sides of it. Such was the case in the instance here figured, where the section has passed through the roughened portions, but the whole of the carious part has been removed. It is quite unnecessary to remove the parts affected merely with this external inflammation. But the whole of the ulcerated and softened bone-tissue must be carefully eradicated. As to the thickened synovial membrane, which so often lies around the diseased joint-ends, it is well, I think, to cut away as much of it as can be removed without trouble or risk; but I have not observed any harm from leaving small portions of it behind. Before the patient has recovered his consciousness, the limb should, in all cases, be carefully

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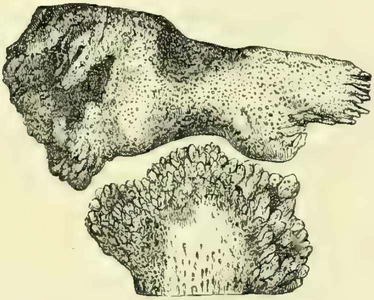
* Some very good surgeons, however, occasionally resort to partial excision of the elbow. See for example a case of partial excision of the elbow (limited to the head of the ulna) reported by Mr. De Morgan in the *Path. Soc. Trans.* xix. 323.

Fig. 365.



Portions of bone removed in an excision of the elbow. From a preparation in the Museum of St. George's Hospital.

secured upon a splint, in the position it is intended to maintain for the first few days after the operation. This position need not necessarily be the one most favourable for ankylosis, except where bony union is desired. In that case the limb ought never to be moved, if it can be avoided, out of the position in which it is intended to ankylose; and the first dressing, or change of splint, after the operation ought to be delayed as long as due attention to cleanliness allows.

As to the instruments required in excisions, little need be said. These operations are no exception to the general rule, that difficulties are better overcome by the dexterous use of common instruments than by the invention of special and often complicated apparatus. The elaborate instruments described, usually in French surgical works, appear to be really intended to save the surgeon from the necessity of thoroughly exposing the bones, by turning down proper flaps, and thus to enable him to remove the bones piecemeal; and if so, their principle is radically bad. The chain-saw, which seems to be much used in France, is hardly ever employed in England, though it may be useful occasionally in deep-seated parts. Some operators like to steady the bone, and guard the parts around, by passing under it a large director, mounted on a handle;* and such an instrument may be very convenient when the bone cannot be turned out of the wound. The saw called by the name of its inventor, Mr. Butcher, will often be found useful, but for ordinary purposes I prefer to use a common amputating saw. The large bone forceps, with a double jaw, called by Sir W. Fergusson 'the lion-forceps,' are almost indispensable for holding firmly the piece of bone which is to be sawed off. These instruments, together with cutting-pliers, a keyhole-saw, gouge, chisel, trephine, blunt bone-forceps, and curved spatulas, are all the special apparatus necessary.

The bones to be removed ought always to be taken away as clean as possible, and if, in removing entire bones or portions of their shafts, the periosteum can be left behind, it will no doubt be an advantage, as tending to give more firmness to the cicatrix.

Subperiosteal Excision.—The general question of subperiosteal resections has lately been brought into much prominence by the labours of M. Ollier, and by the interesting work which he has published on the subject.* The operator will find that in many conditions, at any rate, of disease—possibly in most of those in which he is called upon to operate, and in many subjects previously healthy, especially in early life—the periosteum can be stripped off the bone with moderate facility, by using raspatories or chisels with somewhat blunted edges, such as are figured in M. Ollier's work.† When this has been done a chain-saw can be insinuated between the detached periosteum and the bone, and the latter removed almost or altogether clean. In amputation of the thigh I have frequently dissected off a sleeve of periosteum from the femur before sawing it through —using this periosteum to cover the section of the stump of the bone; and in many other regions of the body I have convinced myself of the ease with which the periosteum may be entirely separated from the surface of the healthy bone. In many diseased conditions the separation is made still more readily. In fact, in necrosis, and in the advanced stages of caries, the periosteum separates from the bone almost spontaneously. There are other conditions (those in which active inflammation is still in progress but has not proceeded to suppuration) where the periosteum adheres too closely to the bone to be separated without an amount of tearing and violence fatal to its integrity, and in such conditions the attempt if commenced ought to be abandoned.

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* See the Essay on SURGICAL INSTRUMENTS.

There are various advantages and disadvantages connected with the preservation of the periosteum in excision. The bone will be reproduced, to a certain extent at least, and perhaps entirely.‡ This reproduction will give firmness to the cicatrix in case of excision of an entire bone, will fill up the gap and add length to the limb in case of resection of a portion of the entire shaft of a long bone, and will reproduce the articulating portions and the processes for the attachments of muscles around an excised joint. Again, since in the subperiosteal proceeding, the tendons of the muscles are detached entire from the bone, they will not be so much injured as in the ordinary operation, and will probably obtain better leverage. Finally, as the instrument is kept all the time close upon the bone, there is much less risk of injury to the neighbouring vessels and nerves. On the other hand, the operative proceeding is long and tedious; it is difficult to remove the bone without detaching the periosteum to some extent from the part left behind; if the periosteum is much handled, it is liable to slough, which delays the healing of the wound and endangers the success of the reparative process; and the reproduction of bone is by no means an undoubted benefit—in many cases is certainly undesirable. Subperiosteal resection, therefore, appears to me inapplicable in several of the special excisions, as will be pointed out in the sequel.

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* *Traité expérimental et clinique de la Régénération des Os.* Paris, 1867.

† I am quite ready to admit, if it is a matter of any moment, that in the last edition of this work I had over-estimated the difficulty of detaching the periosteum in a continuous layer. Subsequent experience in several cases on the living subject has convinced me that this is not only possible, but easy in a great number of cases.

‡ One of the most striking instances of this reproduction is found in the account by Dr. Doutrelepont of the dissection of a specimen of subperiosteal excision of the elbow, which will be referred to under the head of Excision of the Elbow.

EXCISIONS IN PARTICULAR.

Excision of the shoulder, as the term is ordinarily used, is intended to signify merely the removal of the head of the humerus. The operation is practised in preference to amputation at the shoulder-joint in cases of gun-shot wound or compound dislocation, when the injury is not too extensive; and is the only operation admissible in chronic disease of the joint. But in cases of rapidly growing tumour of the head of the bone, amputation would seem the more prudent course; and still more so, if the tumour were known to be cancerous. In ankylosis—an affection which is rare in the shoulder—no cutting operation is justifiable.

The head of the bone may be removed, if there is not much thickening over the joint, by a single incision running downwards as far as may be judged necessary from the upper part of the acromion process, over the most prominent part of the head, where it is most plainly felt beneath the skin. This line of incision corresponds pretty nearly to the direction of the long tendon of the biceps muscle. In some cases it is necessary to make a flap out of the deltoid muscle, of a somewhat triangular shape, with its base upwards. The precise position of the incisions which bound this flap is a matter of secondary importance, and is usually determined by that of the sinuses or wounds. The head of the bone, having thus been exposed, is to be rotated (when the shaft is entire) first outwards, in order to stretch the tendon of the subscapularis, then inwards, to make tense those attached to the greater tuberosity; these tendons are to be divided, and the capsule thus freely opened, and then the head of the bone is to be thrust out of the wound, and sawn off. If the case is one of injury, and the head of the bone is severed from the shaft, it must be seized with the lion-forceps, and dissected out. The bleeding is usually free, from the posterior circumflex artery or its branches. If the long tendon of the biceps can be distinguished, it should be spared. In both disease and injury, the glenoid cavity often escapes; but if it should be found affected, it may be thought necessary to remove it. This is best done with a large chisel or with bone-nippers of appropriate shape. The parts should be lightly put together by means of a few sutures, and the patient confined to bed for the first few days, until the consecutive fever has passed over. He may then be allowed to move about, the elbow being carefully supported. The tendency of the muscles, which form the flaps of the axilla, to displace the bone may be counteracted by a pad in the armpit.

M. Ollier believes that the subperiosteal method is even more applicable in the resection of the head and upper part of the humerus than in any other excision, and has given a very interesting instance of its successful performance in a case where, besides the head of the humerus, more than four inches of the shaft were removed.* The resulting shortening did not exceed half an inch. The subperiosteal excision of the shoulder is not so difficult as some of the other similar operations. An incision being made in a somewhat longitudinal direction through the anterior part of the deltoid muscle † down to the bone, the head of the humerus is fairly exposed, and all the tendinous and fibrous structures (including the periosteum, the tendons attached to the greater and lesser tuberosities, and the capsule of the joint), are gradually separated from the bone by the sharp and blunt raspatories. The bone can then be pushed out of the wound, and if it is to be divided lower down the operator proceeds to denude it to any required extent by pushing it upwards out of its periosteal sheath until the saw can be applied. M. Ollier has now practised this operation four times, and in all cases with success, removing two and a half inches of the shaft in one instance, and more than four inches in the case above referred to.*

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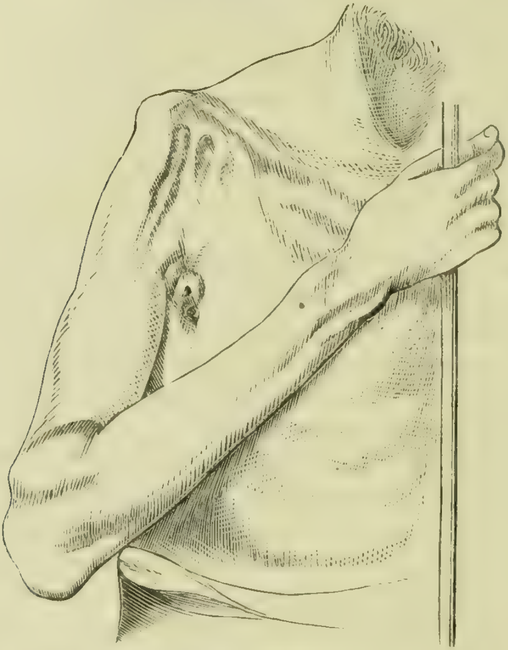
* Case of Louise Gaillard, op. cit. vol. ii. pp. 46 and 514.

† M. Ollier attaches much importance to the preservation of the major part of the deltoid in connection with its nerve—the circumflex. For this purpose it would be desirable to make the incision between the deltoid and pectoralis major, but for the wound of the cephalic vein which this would involve. It is in order to avoid this injury that M. Ollier sacrifices a small part of the deltoid muscle. Other operators, as Nilaton, recommend a transverse incision.

The amount of bone which may be removed in cases of injury, with a prospect of preserving a useful limb, appears to be considerable. Four or five inches of the bone have been removed with good result.† But no doubt the less that can be taken away the better. In cases of injury, provided all the comminuted portion is removed, fractures or fissures running down from the chief seat of injury may be disregarded. In chronic disease of the joint, the affection is usually limited to the head,

Fig. 366.



Drawn from a patient on whom excision of the shoulder-joint had been performed with success many years previously; to show the position of the wound, the shape of the shoulder, and the atrophy of the deltoid and of the upper arm generally.

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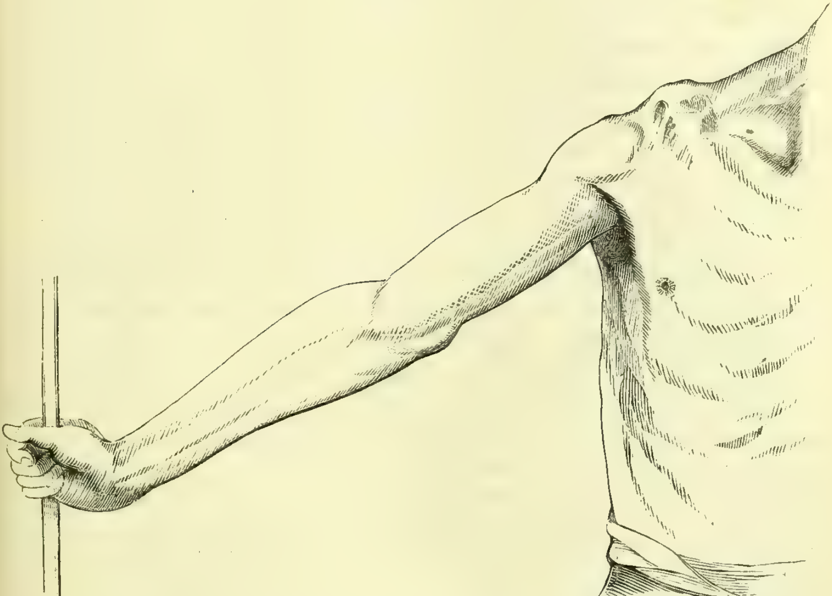
* *Des Resections des grandes Articulations.* Lyon, 1869, p. 15.

† Hodges, op. cit. p. 26; Ollier, sup. cit.

except in cases of necrosis; but in necrosis it is more usual to find the shaft only diseased, and the joint exempt.*

The amount of motion obtained after the most successful resection of the head of the humerus does not seem so great as that which is recovered in some cases of ankylosis after disease. The arm can never, as it seems, be elevated beyond the horizontal line; while in many cases it hangs down, without any power whatever in the deltoid, at a greater or less distance from the scapula. But the movements of flexion, extension, and adduction are usually free; abduction can often be effected to the extent of raising the arm considerably from the side; and there is usually sufficient power in the fore-arm to carry heavy

Fig. 367.



From the same patient, to show the extent of motion obtained. It will be observed that the deltoid, though atrophied, has not entirely lost power.

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* In the celebrated case of White of Manchester, usually quoted as the first in which excision of the shoulder was performed, a large sequestrum was removed; but it does not appear that that sequestrum involved the joint; in fact, the plate in White's *Cases in Surgery*, fig. i. p. 68, clearly shows that the shaft had separated from the epiphysis, and that the part removed was the necrosed upper portion of the diaphysis.

weights, and perform many of the ordinary domestic tasks. This was the case in the patient from whom Figs. 366–7 were drawn. The arm is therefore a very useful one, irrespective of the vast importance of preserving the hand; and the patient is enabled to follow many of the ordinary trades. It does not appear that any advantage is gained by removing the glenoid cavity; while, as far as can be judged,* the operation is rendered more severe and more dangerous to life. Hence, unless disease is clearly present in that part, it should be let alone. 'The average length of time,' says Dr. Hodges, 'before some use of the limb was commenced, as calculated from thirty-one of the cases in my table, was over four months; a much longer period than this was required, however, to elapse before the limb could be said to become really serviceable.' The table in Dr. Hodges's treatise contains fifty cases, eight of which died, and in four others the operation was unsuccessful.

The results which M. Ollier obtained by the subperiosteal method in the only case of excision of the head of the humerus alone which he records, though very good, are not markedly superior to those which have been obtained by the ordinary method.† In the case in which he removed the head and about half the shaft of the humerus, the following is his account of the result. 'The shoulder is of rounded form, not only is the bone reproduced in length, but the scapulo-humeral joint is reconstituted. The end of the new bone articulates with the glenoid cavity by a joint of the enarthrodial type—that is to say one capable of movement in all directions. All the muscles of the shoulder have recovered their action. The deltoid, which in most of the old operations remained atrophied and paralysed, is capable of energetic contraction. The rotator muscles are inserted on to the end of the reproduced bone, by means of the old capsule with which they have preserved their former relations.' ‡

Excision of the scapula and clavicle.—Excision of the scapula has been occasionally practised on account of necrosis, or the bone has been removed, together with a tumour growing from it: the excision, however, in the latter class of cases has usually been only partial, *i.e.* only the portion of the bone implicated in the tumour has been removed. The operation in such cases has usually been protracted and bloody; § and it may be added that in most of the published cases it was of very doubtful benefit; the tumour being either of a malignant nature, and returning in spite of the operation, which did not seem to prolong life; or else being dependent on syphilis, and very probably curable without any operation at all.* These considerations—added to the great severity of the operation in cases of rapidly growing tumour, where the large arteries which surround the scapula on all sides are enlarged for the supply of the new growth—ought to make the surgeon very cautious in recommending such operations. The operations on the scapula for necrosis, like all other operations for this affection, have turned out much more satisfactorily; but they bear more resemblance to the usual proceedings for the extraction of sequestra than to formal operations for excision. A case related by the late Mr. Jones, of Jersey, in the 42nd volume of the *Medico-Chirurgical Transactions*, will illustrate these observations, and will show what useful motion may be preserved even after the removal of a sequestrum involving almost the whole scapula, inclusive of its articular surface. No special directions are needed for these operations. The position of the sinuses will point out the most convenient directions for the incisions, which should be kept as much as possible upon the limits of the bone, in order to avoid as many of the large vessels as can be spared. The bleeding, however, in these operations for necrosis seems far less than in those performed for the removal of tumours.

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* See the cases quoted by Dr. Hodges, op. cit. p. 34. Of the fatal cases there reported (eight in number), there was but a single instance of death where the glenoid cavity had not been interfered with.

† Case of Hinon, *Régénération des Os*, vol. ii. pp. 326, 514.

‡ *Resections des grandes Articulations*, p. 16.

§ See the account by Mr. Liston of such an operation performed for a tumour which he regarded as an ossified aneurism of the subscapular artery; but which

The total excision of the scapula for a tumour should be thus performed. The patient being brought under the influence of chloroform, an assistant should be charged with the compression of the subclavian artery; for which purpose, if the projection of the tumour makes compression difficult, the incisions may be so managed as to enable him to put his finger directly down upon it. This precaution much diminishes the hæmorrhage from the subscapular artery and its branches, which otherwise might be formidable. The surgeon then proceeds to denude the tumour of its outer coverings by turning down appropriate skin-flaps, taking great care, however, not to open the capsule of the tumour itself.† When the whole tumour is thus exposed

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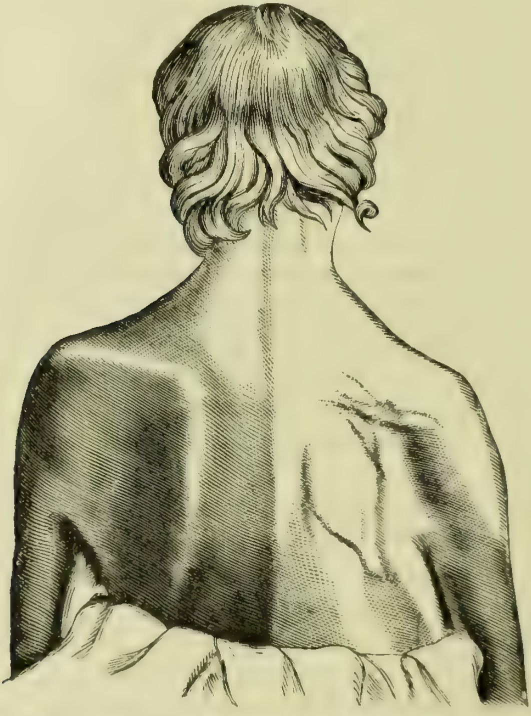
was in all probability a malignant tumour of the bone. *Edin. Med. and Surg. Journ.* vol. xvi. pp. 66, 215.

* *Path. Soc. Trans.* vol. vii. p. 346.

† See Pollock in *St. George's Hospital Reports*, vol. iv. p. 237.

the muscles inserted into the vertebral border of the bone should be rapidly divided, as also those which are attached to the spine of the scapula. The tumour being now movable should be lifted well up, and freed from its other attachments by rapid strokes of the knife, commencing from its *lower* angle. The subscapular artery is divided near the end of the operation, and can be caught hold of by the surgeon or his assistant, and held till the tumour is removed, or can be at once tied. The ligaments of the shoulder are then easily divided and the mass removed.

FIG. 368.



Drawing from the photograph of a patient on whom excision of the scapula had been successfully performed by Mr. Pollock. From *St. George's Hospital Reports*, vol. iv.

The acromion process, if not diseased, may be divided with bone-nippers and left behind to preserve the shape of the parts and protect the head of the humerus.

In this way I have seen the scapula removed with a very large and vascular tumour, without any serious bleeding.

Mr. Syme appears to have been the first surgeon who attempted and successfully performed this severe operation,* in the year 1856. The published cases, as far as I know, are twelve in number, five of which have died.†

The resulting deformity is very slight, especially if the acromion has been left behind to preserve the shape of the shoulder, as was done in the case from which Fig. 368 was drawn. The patient was under Mr. Pollock's care at St. George's Hospital.

Almost the same general observations will apply to the excision of the clavicle as to that of the scapula—only, as the relations of the clavicle are far more important than those of the scapula, so must even greater caution be exercised in undertaking its removal. It is not only that very large vessels lie in the neighbourhood, which it may be difficult to avoid during the removal of a large tumour passing into the root of the neck, and perhaps lapping over them; but also that the removal of such a tumour from below the deep fascia of the neck involves alarming risk of death from diffuse inflammation. The benefit to be derived from such an operation ought therefore to be most clearly proved before its dangers are encountered.‡ In operations for necrosis the proceeding will be far more simple, and is likely to be far more successful. The sequestrum will probably be separated from the subclavian vein and the deeper parts by a deposit of new bone, and the patient will have a fair chance of permanent recovery. In operating on the clavicle for a tumour, the incisions should be made very free, one over the long axis of the bone, joined by others in appropriate places for turning down such flaps as may appear necessary, and the parts to be operated on should be brought fairly into view before the bone is meddled with. After having freely divided all the superficial attachments of the bone and tumour, the next step is to divide the outer end of the clavicle from the scapula, either by cutting through the joint or by severing the bone with a small saw or nippers. Then the part which is to be removed can be raised, and must be separated with great care from the important parts which lie below it, so as to reach the sternal part, which is last divided, and which serves during the operation as a pivot on which the bone can be moved and supported; or, in other cases, it may be found more convenient to divide this part of the bone also at an earlier period of the operation.* It appears that very useful motion may be recovered after the removal of a large part, or even the whole, of the shaft of the clavicle.

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* On Excision of the Scapula, 1864.

† Ten cases are referred to in the *New York Med. Journ.* 1866, and in the *New Syd. Society's Biennial Retrospect* for 1865-6, p. 220. Three of these died. Another case is related in Mr. Pollock's paper in the volume of the *St. George's Hospital Reports,* and one under Mr. Sydney Jones's care in the *Lancet* for Nov. 21, 1866. Both of these latter proved fatal.

‡ In Mott's case the operation lasted *four hours,* and thirty vessels were tied. Mott says, 'This operation far surpassed in tediousness, difficulty, and danger, any thing which I have ever witnessed or performed.'

After amputation at the shoulder-joint, the scapula has been extirpated for recurring disease, and portions of the clavicle have been simultaneously removed. One case is on record in which Mussey, of Cincinnati, removed the whole clavicle and scapula for a tumour recurring after amputation at the shoulder-joint.† The patient survived the operation, and was heard of in perfect health thirty-four years afterwards at the age of seventy-one.‡ No directions can be required for the performance of an operation which must vary in its steps according to the condition of the parts left behind after the amputation. Mussey commenced from the inner side, so as to expose and tie the subclavian artery early in the operation; and this would probably be the best course if the state of parts should allow of it. He nearly lost his patient from the passage of air into the subclavian vein.

Excision of the elbow for disease may be thus performed. The bones are exposed by a free vertical incision, running parallel and a little external to the ulnar nerve, about four inches in length, having its centre opposite the tip of the olecranon. This suffices for all ordinary cases. If more room is required, the vertical incision may be crossed by one running outwards from its centre. I have not for many years used the old H-shaped incision. If, however, this method be adopted (as may, perhaps, be occasionally advisable in cases accompanied by much thickening or by firm ankylosis) two lateral incisions should be made running over either condyle, and united by a transverse cut across the olecranon process. The flaps should then be thrown back and the ulnar nerve dissected out. In the ordinary operation with a single incision, if the head of the radius is found dislocated on the back of the outer condyle (a very common condition in chronic disease of this joint), it may be removed at once with the bone-nippers. The joint should now be freely opened by dissecting round the olecranon, care being taken to keep the edge of the knife close against its inner side, in order to avoid the ulnar nerve, which is usually hidden from view amongst a mass of indurated cellular tissue. The end of the humerus should then be cleaned and turned out of the wound, the lateral ligaments being freely divided; the tip of the olecranon having been previously cut off, if necessary. However slight the disease in the bones may be, the whole end of the humerus just above the condyles ought to be removed. Afterwards the sigmoid cavity of the ulna should be sawn away. It is better, when it can be done without inconvenience, to make the sections of the two bones of the forearm on the same level. The wound should be brought together lightly. The limb should then be lightly bandaged on an angular splint, before the patient is restored to consciousness.* If troublesome hæmorrhage occurs from the articular arteries at the beginning of the operation, an assistant should compress the brachial, and any vessel which continues to bleed after the removal of the bones should be carefully secured.

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* See Travers, in *Med.-Chir. Trans.* vol. xxi.

† *Amer. Journ. of Med. Sc.* vol. xxi.

‡ *Health; its Friends and its Foes.* Mussey, p. 352.

Ollier, Langenbeck, and others endeavour to preserve the periosteum in this excision.† For this purpose, after a free longitudinal incision over the olecranon, the periosteum is also to be freely incised and separated from the olecranon with a blunt or half-blunt instrument; then the tendon is to be carefully separated from the olecranon, leaving it still attached to the periosteum and surrounding fascia. In exposing the rest of the bones similar precautions are to be taken to preserve the periosteum and tendons in relation with each other and with the fascia. The advantages claimed for this method are that more perfect reproduction is said to ensue, and with more extended motion. Dr. Huëter asserts that the new joint is even provided with synovia, and he says that the movements of the new joint are sometimes more extensive than those of the natural elbow. Thus in one case the patient could lay the flat of his hand on the shoulder of the side on which excision had been performed, which was, of course, impossible on the sound side. This fact, however, seems to me rather to show the absence than the abundance of reproduced bone, and I shall show that the same freedom of motion exists after the ordinary operation. In M. Ollier's work the reader will find the most ample details on the 'manuel opératoire,' and on the results of this subperiosteal method of excision. His method of operation differs, though only very slightly, from that of Langenbeck. He gives a table of twelve cases operated on in the hospitals at Lyons.* Three of these died—a large proportion—due, as he believes, to the unhealthiness of the hospitals in which the patients were treated. In two of the other cases, the time which had elapsed was insufficient to allow of an opinion on the result. All the others had good movement, though in one (M. Dron's case) it seems to have been limited. One of the patients died (of scarlet fever) eight months after operation; but unfortunately an examination of the new joint was not obtained. It must be admitted, therefore, that the only perfectly convincing proof of the reproduction of the articular ends is still wanting in this series of cases. M. Ollier is, however, perfectly certain of the reproduction of a bony mass replacing the olecranon in most of the cases, and of the attachment of the tendon of the triceps to this bone; and also, in some instances, of the reproduction of bony projections from either side of the end of the humerus, giving great lateral stability to the joint. On the whole, therefore, I think we are entitled to conclude that the subperiosteal resection of the elbow, though more laborious than the older methods and requiring more time for its accomplishment, has occasionally yielded excellent results, and deserves to be tested by more extensive practice.

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* Some surgeons—and among them, I believe, Mr. Syme (see his treatise on *Excision of Diseased Joints*, 1831, p. 70)—merely flex the arm, and apply a roller; but the support of a splint appears to give confidence, and to prevent spasmodic movements: it need not be applied at any particular angle, but merely in such a position as avoids tension on the sutures.

† I would refer the reader on this head to Huëter, in Langenbeck's *Archiv.* vol. viii. pp. 135, et seq.; Lücke, *Aphorisms of Military Surgery*, &c. p. 126. Stokes, in *Dublin Quarterly Journal*, May 1865, and especially to Ollier, *Traité expérimental et clinique de la Régénération des Os.* Paris, 1867, vol. ii. pp. 338, et seq.

My own experience of this method is limited to a single case,† in which, although it was a very good case for excision, and no bad symptom followed the operation, the motion ultimately obtained was considerably less than in a perfectly successful operation after the ordinary manner; and this appeared to me to depend on the excessive reproduction of the excised olecranon. Dr. Doutrelepont ‡ has published an account of the dissection of a case in which this operation had been successfully performed at the age of 18, about four years before death. In this case the olecranon and coronoid process of the ulna, the head of the radius, and two-thirds of an inch of the humerus, were removed, the section of the latter bone running through the condyles. The drawings attached to Dr. Doutrelepont's paper show that the condyles of the humerus had been entirely reproduced—the internal condyle rather exuberantly, forming a deep groove for the ulnar nerve. The olecranon was also reproduced, and was longer and more curved than natural—a circumstance of much importance. The head of the radius was also reproduced, and was united to the ulna by an orbicular ligament, as in the natural joint. There was a regular joint between the ulna and humerus (an articular surface, surrounded by a capsule, being formed on the summit of the reproduced sigmoid notch), and true hyaline cartilage had also been reproduced. There was no appreciable shortening of the arm, and the muscles were as well developed on that side as on the other. Pronation and supination were almost natural, flexion and extension were perfectly good, but within the limits of 75° to 120° only.

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* A somewhat larger number of cases is given in M. Ollier's more recent publication, *Des Resections des grandes Articulations*—nineteen cases, with four deaths, which, however, were all in adults. Out of eleven cases under 30 years of age, none died.

† The *Practitioner*, No. viii. Feb. 1869, p. 65.

‡ Langenbeck's *Archiv.* vol. x. p. 911.

In my own case, also, the limits of flexion and extension are about the same as the above; and here, also, I thought that extension was checked by the excessive reproduction of the olecranon, whereby its point was brought down into the coronoid fossa before the arm had been nearly straightened. M. Ollier has pointed out the danger of this limitation of motion by the curved shape of the new olecranon,* and proposes to rectify it by treating the arm in a more extended position than that ordinarily used, with adequate precaution, of course, against ankylosis.

Mr. Stokes, of Dublin, has been so kind as to inform me that he has practised the subperiosteal excision of the elbow five times. The first two operations, in children aged about 10 and 12, did extremely well, the wounds healing rapidly, with obvious reproduction of bone and excellent movement. The third patient died about two months after operation, and there was no opportunity of examining the joint. In the two other cases (adults), the power of flexion and extension was extremely limited—one almost ankylosed.

From all that I have seen and read on the subject, therefore, I must say that the advantages of the subperiosteal method in this excision are at present doubtful.

The extent of bone which may be removed in an excision of the elbow is considerable; in fact, within the proper limits, it seems as if the more bone is removed, the better is the result. If only the extreme ends of the bones be sawn off, ankylosis will most likely take place; while if the amount above prescribed (viz. the whole condyloid extremity of the humerus and all the sigmoid cavity of the ulna with the head of the radius), or even a little more on both sides, be taken away, free motion may, under favourable circumstances, be expected. An exaggerated idea, however, appears to prevail, of the amount of bone which may be excised with a prospect of preserving a useful limb. This idea has originated from confusing operations undertaken for necrosis with those for injury or chronic disease (caries).

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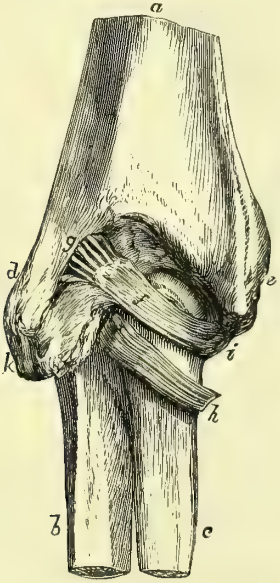
* *Traité experimental, &c.* vol. ii. p. 347.

In the former, the whole shaft of a bone has often been removed, and a useful limb left. In the latter, especially if the periosteum be removed with the bone, only a limited quantity of bone can be taken away. If the limits above pointed out have been somewhat exceeded, and still at the point of section the interior of the bones is obviously diseased, it is better, if the disease is not in a very advanced condition, to remove all the bone which is quite disintegrated, preserving what is merely softened, and thus give the patient a chance of saving his limb; but if complete disorganisation extends far into the shaft, it is, I think, advisable to amputate, although perhaps in a young and healthy patient the operator might be justified in trying the subperiosteal extirpation of the diseased bone. The position of the line of section in relation to the junction of the epiphysis is a matter of subordinate importance in this joint, since it is of much more importance to obtain a flexible but firm union, so as to allow of good motion, than to avoid any amount of shortening of the affected arm.

The arm should be left perfectly quiet for a few days, in the position in which it has been placed after the operation. A good deal of irritative fever often supervenes. When it is necessary to change the dressings for the sake of cleanliness, a grooved splint should be applied, which will lodge the arm and forearm, and which is jointed in the centre and movable by a rack and pinion; with this apparatus, the arm may easily be got into such a position as will afterwards be useful, by gradually changing the angle. Passive motion, however, of a more vigorous kind must not be neglected, the time at which it is commenced varying with the state of the wound and the quantity of the bone which has been removed. If much has been taken away, ankylosis is little to be apprehended; otherwise, at a period which may be roughly stated at about three weeks, daily passive motion ought to be commenced. In the most favourable cases a very perfect false joint succeeds to this treatment; and an amount of motion is regained, which for practical purposes is little inferior to that of the original joint.

Of this a very interesting example is recorded by Mr. Syme, in which he had the opportunity of dissecting the new joint, nine years after the operation, which had been performed on account of injury—the man having in the interval acted as guard on a railway, swinging himself from one carriage to another while the train was in motion, with the injured arm, quite as easily and securely as with the other. The ulna was found united to the humerus by ligament; the end of the radius was polished off, and played on the humerus and on the ulna, a material something like cartilage being interposed. The ends of the bones of the forearm were locked in by two processes projecting downwards from the humerus, and strong lateral, and still stronger anterior and posterior, ligaments also bound them to the latter bone.

FIG. 369.



Reproduction of the elbow-joint after excision, in Mr. Syme's case. (From the *Lancet*, 1855, vol. i.) *a*, the humerus; *b*, the ulna; *c*, the radius; *d*, *e*, projections from the shaft of the humerus, locking in the bones of the forearm in the new joint; *f*, new orbicular ligament around the head of the radius; *g*, a portion of the ligamentous union between the ulna and humerus; *h*, tendon of the biceps; *i*, *k*, new lateral ligaments, attached below to the end of the ulna on one side, and the orbicular ligament on the other.

Union, is, however, seldom so perfect as this, and the bones seem to be united merely by more or less extensible ligament.* In these cases, it is said by M. Robert † that flexion is composed of two movements; the forearm being first drawn up to the humerus by the triceps, and then flexed by the action of the biceps.

I append drawings from a case in which I excised both elbow-joints of a child aged five, four years since.‡ The drawings show the amount of motion obtained in a perfectly successful case by the old method, and they prove that when the preservation of periosteum is quite disregarded the same extent and freedom of motion may be obtained as Dr. Hüeter (above quoted) appears to believe to be peculiar to the subperiosteal operation. Mr. Syme's case also shows that considerable reproduction of bone may ensue, by growth from the sections, irrespective of periosteal reproduction. These facts, together with the obvious and proved inconvenience of superabundant bony reproduction in this operation, tend still further to make us hesitate in admitting, without further experience, the advantages of the sub-periosteal method.

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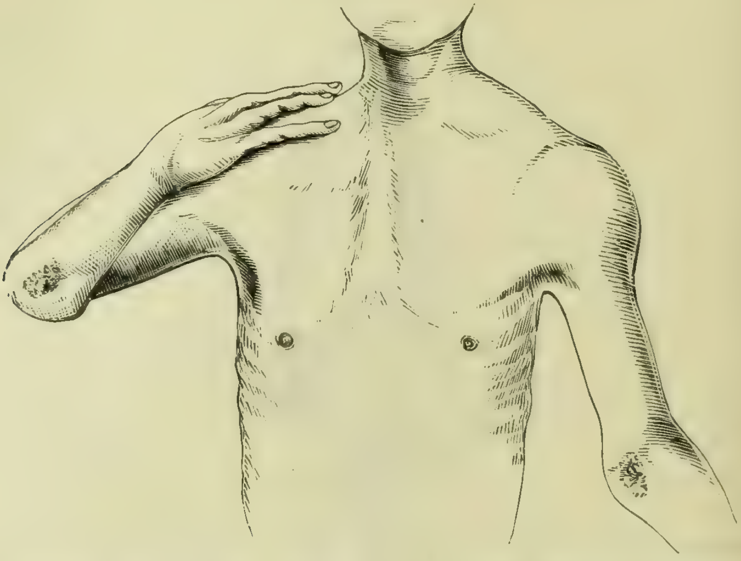
* Notes of the dissections of several cases, after successful excision of the elbow, may be found in Wagner *On Repair after Resection*—translated by the writer for the New Sydenham Society, 1860.

† *Gazette des Hôp.* Nov. 20, 1858.

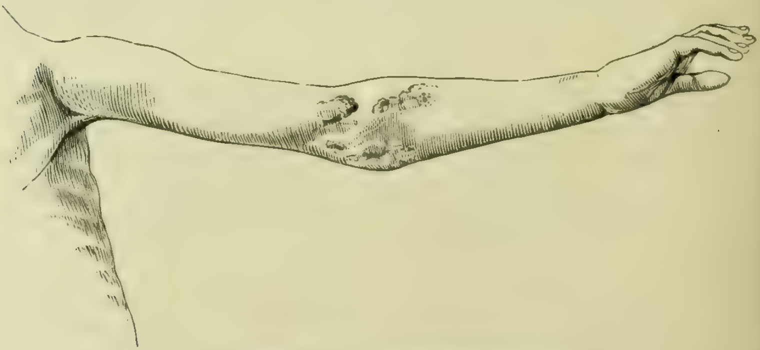
‡ *Clin. Soc. Trans.* vol. i. p. 143.

Fig. 370.



The excised elbow in extreme flexion. It will be noticed that this motion is more extensive than in the natural joint, the hand being laid flat on the shoulder.

Fig. 371.



The excised elbow in extreme extension.

Osseous ankylosis ought very rarely to occur. If the ulnar nerve be injured, a good deal of wasting of the muscles and loss of motion has been observed to follow, and that even in parts not supplied by the injured nerve; and this fact should make the operator careful to avoid the nerve. On the other hand, cases have occurred to the most experienced operators, in which the nerve was wounded; and one is on record in which it re-united, and no loss of motion or other ill consequence followed.* If the patient recover, but with disease persisting or recurring in the ends of the bones, the question of again excising the diseased portions will occur. If necrosis be present, no doubt can exist of the propriety of removing the dead portions, should they be loose; but if the exposed parts of the bone be fixed, or if the disease be caries rather than necrosis, no operation should be performed while the functions of the member appear to be improving. When this is not the case, it is right to try once more to remove the diseased bone before sacrificing the arm. Even a third such attempt has been made, and, as it is said, with good results.

Excision of the elbow is usually considered, and in all probability correctly, as a more formidable operation in respect of mortality than amputation of the arm; but no data exist, as far as I am aware, for a correct comparison between the two In Dr. Hodges's work there is a table of 119 cases, principally from the journals and other published sources: of these, 15 died; and in 15 others amputation was performed. In the great majority of the cases which survived, the usefulness of the limb was proved by the patient being able to resume his ordinary avocations; but the details as to the extent and kind of motions which resulted are not exact.

In the essays on INJURIES OF THE UPPER EXTREMITY and GUNSHOT WOUNDS the reader will find the indications for amputation, excision, or entire preservation of the limb, in cases of injury. In cases of ankylosis of the elbow excision is rarely required, although where true bony ankylosis has occurred in a bad position, excision may be performed if the patient wishes it; but in bony ankylosis in the flexed position, and in all cases of soft ankylosis, this operation is inadmissible. The former ought to be let alone; the latter are under the control of the methods described in the essay on ORTHOPÆDIC SURGERY. In cases of disease of the bones of the elbow excision is the operation which should be adopted, except under special circumstances necessitating amputation, such as unusual extent of implication of the bones, advanced age, great debility, or constitutional affection. But the rarity of such circumstances is shown by the fact, that Mr. Bryant's collection of 300 amputations * only includes 10 in which the arm was amputated for disease of all kinds. So that excision of the elbow is the operation almost universally resorted to in cases of incurable disease of that joint.

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* Syme *On the Excision of Diseased Joints,* 1831, case viii. pp. 88-94.

Excision of the wrist. The operation of excision of the wrist has been entirely modified since the first edition of this work, in consequence of the labours of Professor Lister, of Edinburgh, published some years since in the *Lancet.* He has shown that the failures, to which the old methods of performing this operation usually led, were due in all probability to two chief causes, viz. (1) a portion of the diseased articular structures having been left behind, and (2) the tendons having been injured. In order to avoid the former, it is necessary to remove all the bony and cartilaginous structures which enter into the formation of the wrist-joint itself, and of all the carpal joints; viz. the ends of the radius and ulna (which must be divided at a level above the joint between those bones), all the carpal bones, and all the articulating surfaces of the metacarpal bones. In order to avoid the second cause of failure, the operation must be performed through two very free lateral incisions, the tendons being carefully separated from the bones and raised by gradual strokes of the knife with as little violence as possible. For this purpose an incision is made commencing in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon, as high as to the base of the styloid process of the radius. The soft parts, including the extensor secundi intermodii, and the radial artery, being cautiously detached from the bones external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made. It should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin and should be cut as near its insertion as possible. Then the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded, until the two wounds communicate quite freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing

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* *Med.-Chir. Trans.* vol. xlii.

Fig. 372.

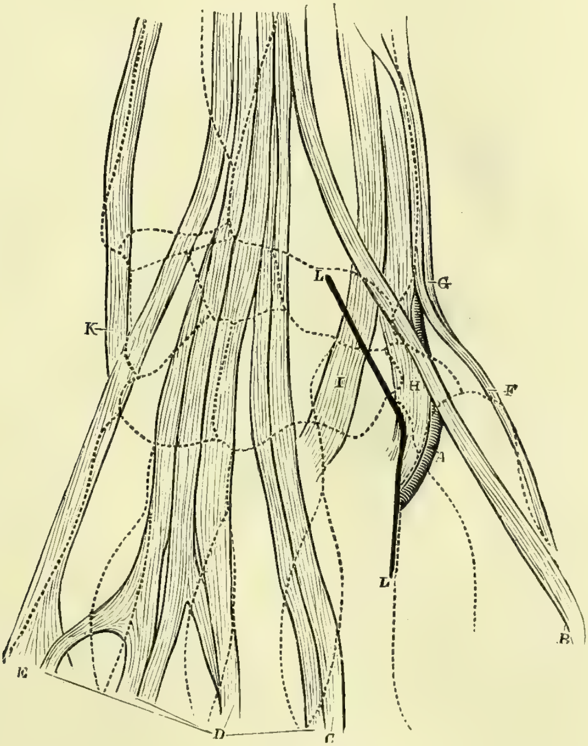
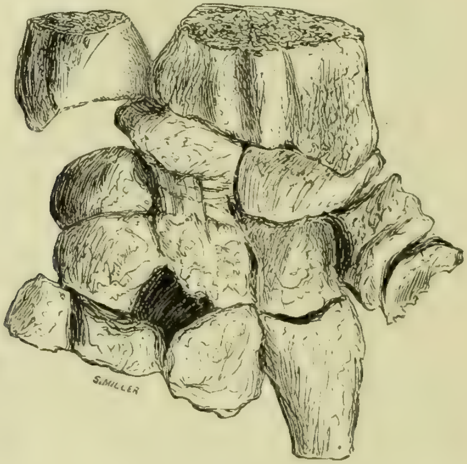


Diagram of the excision of the wrist (after Lister). A, the radial artery. B, tendon of the extensor secundi internodii pollicis. C, indicator. D, Ext. comm. digitorum. E, Ext. min. dig. F, Ext. prim. int. pol. G, Ext. oss. met. pol. H I, Ext. carp. rad. long. and brev. K, Ext. carp. ulu. L L, line of radial incision.

which the pisiform bone and the hooked process of the unciform are severed from the rest of the carpus, the former with the knife, the latter with the cutting pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided, they are to be removed with blunt bone forceps. Next the end of the ulna is made to protrude from the incision, and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones, which are pushed out from one or the other incision and cut off with the pliers so as to remove the whole of their cartilage-covered portions. The trapezium bone, which was left in the early stage of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of the flexor carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away; but the nonarticular part is left

Fig. 373.



The parts removed in excision of the wrist (after Lister).

behind unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform.

The operation is one of the most tedious and difficult in surgery, but it appears to me to give very satisfactory results, and therefore should, I think, always be adopted in such cases as are favourable for any operation at all. It is advisable, if not necessary, to put on the tourniquet; so that the view of the parts should not be obscured by blood. It is also very desirable to break down freely any adhesions which the tendons may have formed, while the patient is under chloroform previous to the operation.

No tendons are divided in this operation except the extensors of the wrist, for the flexor carpi radialis is inserted lower down than the point at which the metacarpal bone is usually divided.

In order to ensure motion, particularly in the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Mr. Lister places the limb on a splint with the palm of the hand raised by a large wedge of cork, fixed below it; so that the joints of the fingers can be moved without taking the limb off the apparatus. Special arrangements are made for keeping the splint steady and for preventing displacement of the hand to either side. Careful and methodical passive motion should be used to each several joint—to those of the finger and thumb almost from the day of operation, and to the wrist as soon as the parts have acquired some firmness, each movement, pronation and supination, flexion and extension, abduction and adduction, being separately exercised; and the patient should be encouraged to make attempts at voluntary motion as early as possible. In order to exercise the fingers, the portion of the splint which supports them may be removed while that on which the wrist is received is still left. Finally, when the rigid splint is left off, some flexible support is still to be worn for a long time.

Partial excisions of the wrist are, I believe, much less promising, although success may be obtained in some cases, especially those of traumatic origin. Thus Mr. West, of Birmingham, has lately published * an interesting account of two cases, in one of which he removed the ends of the bones of the forearm and the first row of carpal bones for a disease of traumatic origin. Exfoliation occurred from the carpal bones which had been left behind, and the patient recovered with a moderately useful hand. In the second case, one of rheumatic

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* *Dublin Quarterly Journal of Med. Sc.* February, 1870.

disease, an abscess had formed in the lower end of the radius; only the radius was excised. The patient recovered, with the powers of writing and of lifting heavy weights.

The operation of excising the wrist, whether totally or partially, is one which I think is seldom advisable, at least judging from my own experience, for, though anxious to test the value of the operation, I have found only one opportunity in six years in which I thought myself justified in doing so. The results in that case were satisfactory. Nor have I seen more than one or two instances in the practice of my colleagues at St. George's Hospital. In spite of the success of the practice followed by Mr. West, I have a strong preference for total over partial excision. But I have no hesitation in saying that these remarks are only meant to apply to the comparison between excision and the expectant treatment. Many cases, I believe, will terminate quite as well if judiciously treated by incisions when necessary, the removal of portions of bone as they become loose, and, above all, the constant and persevering use of passive motion to the fingers, as if excision be practised, and without the risk of operation. But if the comparison be made with amputation, the removal of the diseased parts being plainly necessary, then the importance of preserving the hand and fingers, even if much mutilated, is so great that excision is the operation which should in all cases be first discussed, and amputation should not be performed unless the less radical proceeding is absolutely contra-indicated.

Excision of single bones of the hand.—The excision of some of the bones of the hand may be practised with advantage, especially if the tendons are unaffected and can be secured from injury in the operation. It is of especial importance to preserve the thumb by the timely excision of its metacarpal bone or first phalanx when universally diseased; and the benefit of resecting the diseased portion, and leaving the articulating head, is of course still greater. If the periosteum can be spared, there will be in all probability a more firm union between the severed ends of the old bone, in consequence of the production of osseous granules, or even larger pieces of bone, in the cicatrix. It is of little use to remove the phalanges of the fingers (except those of the terminal row), unless in a few cases where they are necrosed and loose, for the formal excision of these bones would almost invariably leave a useless finger. But occasionally, especially when the extensor tendons can be spared, the metacarpal bones may be made the subjects of operation; and here, as well as in the thumb, it is of much importance, if the extent of the disease allows it, not to open either joint, particularly the phalangeal.

No precise directions are necessary for such operations, which consist merely in exposing the diseased bone on its dorsal aspect, scraping off from it all the soft parts, including the periosteum if possible, dividing the bone with cutting forceps (the extensor tendon being held out of the way), then seizing the divided end with the lion-forceps, cleaning the bone on the lower surface, with much care not to dip the point of the knife into the palm, and finally, when the limit of the disease is reached, nipping off the bone. If the extensor tendon has been unavoidably severed, the finger must be carefully supported on a splint till this has reunited. In case of disease of the two middle metacarpal bones, it will be better to remove the diseased portions with a small chisel; and this plan is preferred by many surgeons in the other metacarpal bones also, in order to preserve the periosteum.

Excision of the hip is an operation, of the value of which the most widely differing estimates have been formed by different surgeons. Nor is this surprising, when it is considered that the disease for which it is usually undertaken is accompanied by exhausting and long-continued suppuration, rendering the prospects of surgical operation unfavourable; while, on the other hand, spontaneous recovery is so common that it is impossible in any case which gets well after operation to affirm with certainty that the natural cure was impossible. The operation is performed on account of gunshot wound or in advanced 'strumous' disease, accompanied by abscess, where the patient seems in danger of dying of hectic, and the ulceration of the bone is judged to be incurable. The hip-joint ought never to be excised on account of deformity from ankylosis, although it may be advisable in appropriate cases to divide the neck of the femur, or even perhaps to cut a wedge-shaped piece out of it.* The operation of excising the hip, as it is commonly spoken of, means merely the removal of the head of the femur: but the acetabulum may also be removed, if it be thought necessary. The operation differs considerably in difficulty, according as the head of the bone is or is not in the acetabulum, and according as the surgeon does or does not require to obtain access to that cavity in order to remove its floor. In most cases of chronic disease the head of the bone has undergone that process of displacement usually, though not very accurately, spoken of as *dislocation—i.e.* the lip of the acetabulum has been ulcerated or absorbed, and the head of the bone (also altered in shape from ulceration) lies partly on the dorsum ilii, partly on the edge of the expanded acetabulum, and is very probably covered by few if any muscular fibres. In fact, in cases of old-standing hip disease, the muscles have become atrophied from disuse, and the ligaments also have in a great measure disappeared. All that is necessary in the operation is to make an incision of sufficient length over the prominence of the bone, running somewhat behind the trochanter, and, having exposed the head of the bone, to saw it off at such a level as the extent of the disease seems to indicate. When, however, the head of the bone remains in the joint, and the ligaments are entire, as is the case generally in excision for injury, and in many of those for disease, the operation is not quite so simple; and it becomes still more difficult if the neck of the bone is fractured, so that the surgeon cannot get any purchase upon the head to turn it out of the acetabulum. In such cases an incision must be made, running behind and parallel to the posterior border of the trochanter, and long enough to admit of free access to the joint. The length will of course vary according to the size of the buttock, but it may be stated in general terms that the incision should commence near the junction of the trochanter and the shaft, and should curve (with its convexity backwards) round the prominent upper border of that process. By cutting now along the neck of the femur, the situation of the joint may be accurately ascertained, if it has been hidden by swelling from disease or injury; and, this having been done, the parts may be divided from within outwards in any direction which may seem convenient (according to the presence of wounds, &c.), so as to render the external incisions crucial or T- shaped. The

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* I once saw a case in which the hip was fixed in acute flexion. The symptoms induced the surgeon in charge of the case to perform an exploratory operation; but on cutting down, the joint was found free from active disease, but ankylosed. The neck of the femur was sawn through, and the thigh placed on a straight splint. The patient (a child) recovered, with a straight

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and useful limb. In such cases a subcutaneous operation similiar to that practised by Professor Gross on the knee, would probably in most cases be the safest. (See ORTHOPÆDIC SURGERY, vol. iii. p. 728.)

flaps are now to be reflected. If the neck of the femur is fractured, the fractured part is to be seized with the lion-forceps, and cleared up to the head and round it, and so removed. Search should then be made for shots, foreign bodies, fragments of bone, &c. If, on the other hand, the neck of the bone is entire, and sufficiently strong to bear the requisite force, it may be more convenient to turn out the head of the bone, and divide the ligaments, as in ordinary exarticulation; otherwise the neck may be cut through with a keyhole-saw. This instrument should always be at hand, together with a trephine, elevator, gouge, &c. for removing impacted foreign bodies, or for clearing the acetabulum. In many cases the director, mounted on a handle, shown in the essay on SURGICAL INSTRUMENTS, is very useful. I think it better, whenever the disease does not extend very low down, to preserve at any rate a portion of the trochanter.

Thus far we have spoken only of the removal or decapitation of the head of the femur; but since the acetabulum is freely exposed in this operation, it is possible to carry it further, and remove part, or the whole, of the floor of that cavity; and this has been often done with success.

In Mr. Barwell's treatise on *Diseases of the Joints*, p. 444, the reader will find an interesting account of a case in which Mr. Hancock removed the whole of the floor of the acetabulum, together with the head of the femur; and where, on the death of the patient, nineteen months after the operation (his limb having been useful in the meantime, although some disease still existed in the bones), an opportunity of dissecting the parts was presented. Mr. Erichsen removed not only the whole floor of the acetabulum, but also the ramus of the pubes and ischium, with part of the tuberosity of the ischium and a portion of the dorsum ilii; and reports that the patient had a useful limb.* I have obtained a very perfect result in a case from which the annexed figs. (374-377) were taken, where I removed the whole floor of the acetabulum. It is rather inaccurate in such cases to say that the operator has penetrated into the pelvis. A strong fascia still separates the wound from all contact with the viscera or their cellular connexions.

The statistics of this operation are of little real value, nor are they of the same importance as in those excisions where the question lies between the removal of a joint and of a whole limb. The rate of mortality is extremely high; so that out of 111 cases collected by Dr. Hodges,† in which the result was known, 56 recovered 'with more or less useful limbs,' 53 died of the combined effects of the operation and the previous disease, and in the remaining two cases amputation was performed. But it is impossible to deduce any exact conclusion from such facts as these; since, without a personal knowledge of each case, no opinion as to the probability of recovery without operation can be formed. Possibly, more reliable conclusions as to the average mortality of operations may be deduced from the experience of individual operators, though here again there are many sources of fallacy. In my own practice, as stated in a work on the *Surgical Treatment of Children's Diseases*, out of 19 cases (all

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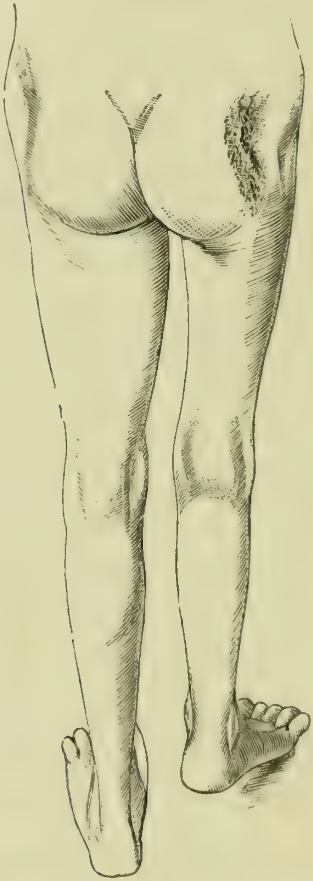
* *Science and Art of Surgery*, 5th ed. vol. ii. p. 241.

† Op. cit. p. 116.

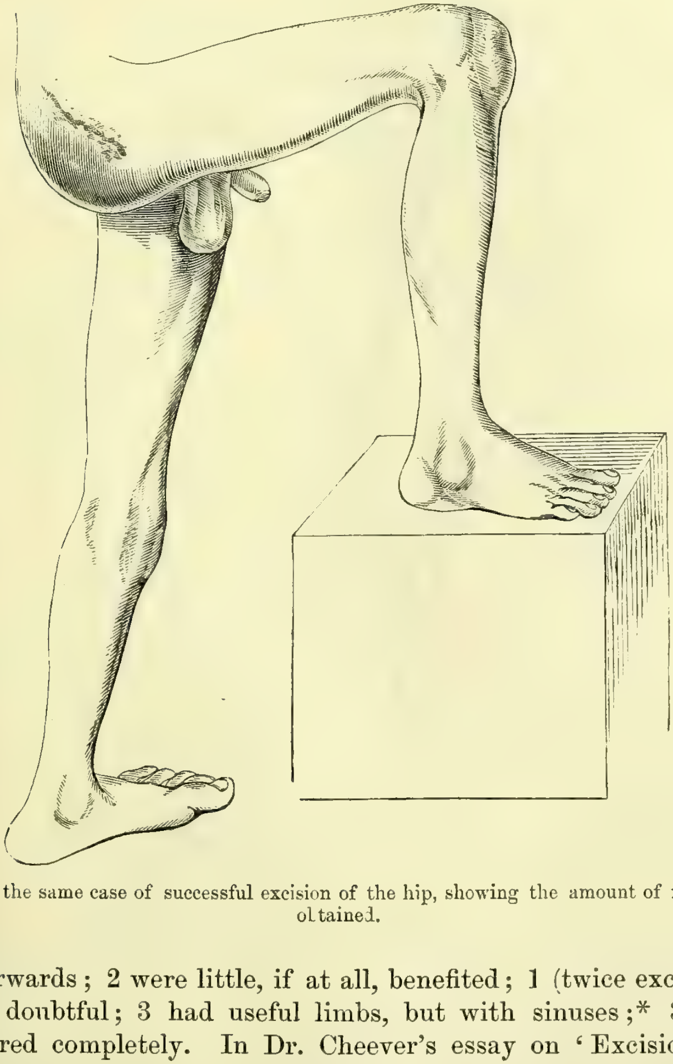
Fig. 374.



Excision of the hip. (From a case in which the whole floor of the acetabulum, as well as the head of the femur, had been removed several years previously.) To show the position of the wound, the amount of shortening, and the wasting of the limb operated on.

children) 6 died from the direct effects of the operation (in one case after amputation); 1 died after the operation from the previous effects of the disease; 1 died of independent disease some time after recovery from amputation; 2 recovered from the operation but not from the disease, and died a long while afterwards; 2 were little, if at all, benefited; 1 (twice excised) was doubtful; 3 had useful limbs, but with sinuses;* 3 recovered completely. In Dr. Cheever's essay on 'Excision of Joints,' in the *Reports of the Boston City Hospital*, 1870, are notes

Fig. 375.



From the same case of successful excision of the hip, showing the amount of flexion obtained.

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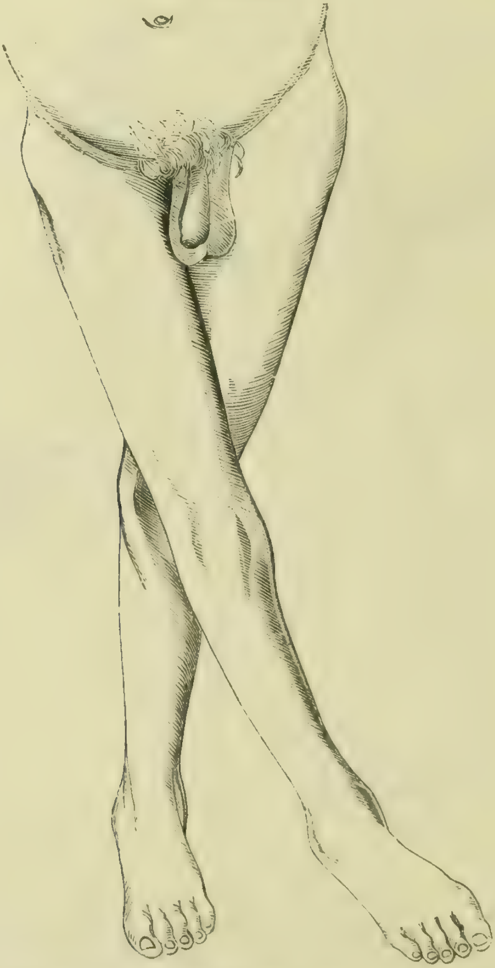
* Some if not all of these have since recovered.

of 11 cases under the care of himself and his colleagues. Two of them were adults, and both died; of the remaining 9, 2 died from tuberculosis, 1 had as yet a useless limb, like chronic hip disease; 3 had useful limbs, but with sinuses; 1 had a good limb, but was lost sight of; 2 had recovered completely.

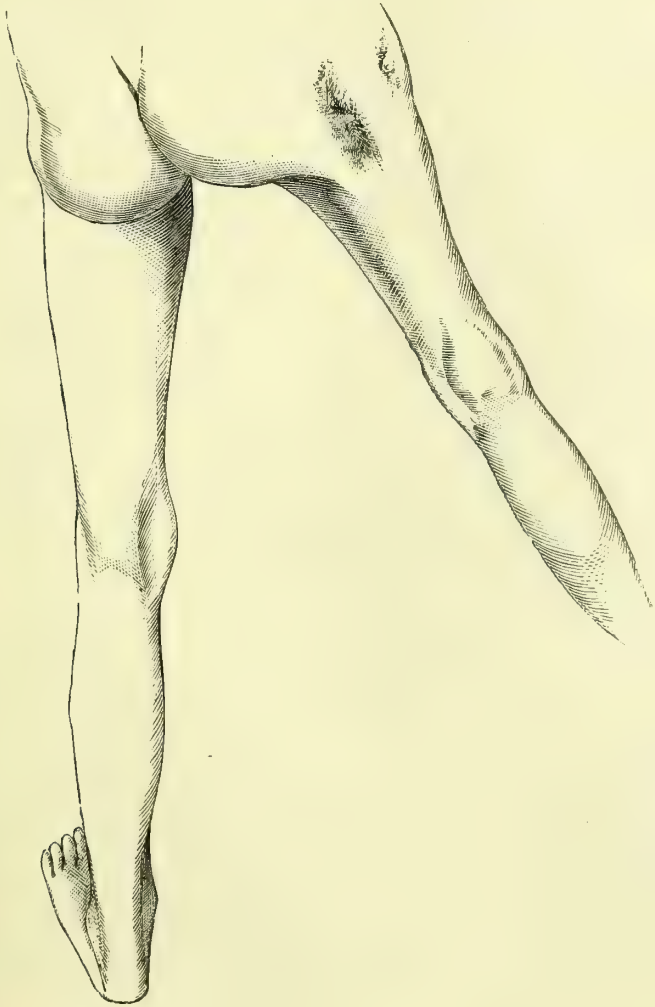
Fig. 376.



From the same case of successful excision of the hip, showing the amount of adduction obtained.

Excision of the hip for injury is a far more formidable operation than for disease. For this there are several reasons. The shock of all primary operations is great, and their mortality very high; nor are secondary operations after injury much more favourable. In the hip-joint the operation of excision for disease is very fatal in adult life, and it is only adults who, as a rule, are operated on for injury; and then again a compound fracture laying

FIG. 377.



From the same case, showing the amount of abduction.

open the hip-joint is in itself a very severe shock, to which that of the operation is to be superadded. Hence we cannot wonder that the records of this operation should present an appalling death-rate. But then excision is only performed in gunshot injuries of the joint; and in these cases primary amputation is almost uniformly fatal,* while the expectant treatment can hardly be said to be much more promising.†

In the essay on GUNSHOT WOUNDS, it has been stated that out of 11 cases operated on in the Crimea, in Schleswig-Holstein, and in the Italian war of 1859, only two patients survived, and one of these after amputation. Reference was also made to the experience of the American Civil War, but as that reference was necessarily imperfect, since the official documents had not then been completed, I think it would be useful to insert the following summary of Mr. Otis's official report on the subject of excision of the hip-joint for gunshot injury, for which I am indebted to Mr. Longmore's kindness.‡ The whole number of excisions of the hip-joint for gunshot injury known to have occurred during the American war was 63—48 in the Federal and 15 in the Confederate armies. Thirty-two of these were primary, i.e. performed within 24 hours of the injury; 22 'intermediate,' i.e. from 2 to 28 days after; and the remaining 9 'secondary;' the shortest interval being 33 days, the longest nearly 7 months. Out of the 32 primary operations, 2 recovered, showing a death-rate of 93·75 per cent.; 2 out of the 22 intermediate—90·9 per cent; and 1 out of the 9 secondary;§ on the whole, 5 recoveries in 63 cases; deaths, 92·1 per cent. Doubtless, the mortality is very high; but viewing the almost necessarily fatal character of the injury, these results may be pronounced satisfactory; and may at any rate encourage a repetition of such attempts. In civil life the opportunity rarely happens; but I remember seeing one case under the care of a former colleague at St. George's Hospital, where I regretted that the operation was not tried. The patient, a young man, in dragging his gun through a hedge had lodged the charge in the hip-joint, the neck of the femur having been cut cleanly across. He died a few days afterwards from the effects of inflammation and abscess in the joint. The pelvis was uninjured.

The average duration of treatment in those of Dr. Hodges' cases in which the point was noted (49 in number) was 230 days. The high mortality and the very protracted period of convalescence certainly show that, even in many of those severe cases of hip-disease which alone are selected for this operation, the patient's prospects are not materially improved by it, although it must be allowed that the concurrent testimony in its favour of many eminent surgeons, who have had ample opportunities of watching its effects, justify a resort to it in cases which seem otherwise hopeless. The immediate effects of the operation are not often fatal, and it is, to say the least, extremely probable that where there is great and exhausting pain from pressure of the diseased bones on one another, the operation may save life. The greatest care, however, should be bestowed on the diagnosis of any case in which excision is contemplated. There are few instances of advanced hip-disease in which the external surface of the pelvis is not more or less involved. This fact (which may be judged of partly by the direction of sinuses, partly by the grating sensation elicited by passive motion under chloroform) is an unfavourable symptom, but forms no insuperable objection to the proceeding.

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* See GUNSHOT WOUNDS, vol. ii. p. 230.

† In the report referred to in the text, Surgeon Otis, U. S. A., writes: 'I continue to share the convictions of Guthrie and the elder authors as to the uniform fatality of such injuries when abandoned to the resources of nature.'

‡ The facts are abridged from the *Brit. Med. Journ.* October 23, 1869.

§ Another successful secondary operation is noticed in the report as having occurred in New Mexico in June 1868.

Abscess communicating with the interior of the pelvis near the joint is a still more discouraging symptom. It ought not perhaps to be stated absolutely (as was done in the first edition of this essay) that it ought to forbid the attempt to excise the joint, since it is possible that, by removing the floor of the acetabulum, a sufficient exit will be provided for the matter.* But even then the removal of the whole of the diseased bone is very improbable, and the operation must be allowed to be very unlikely to succeed. Abscess communicating with remoter parts of the pelvis, or extensive disease of the femur, or the presence of other strumous affections, ought certainly to forbid the attempt.

Adult age is a serious contra-indication to excision of the hip. A few cases of recoveries after the age of 20 are on record; but as a general rule the operation should be confined to childhood. In one of the successful cases in adult life the operation was performed for chronic osteo-arthritis.

The purport of these indications and contra-indications appears to be that excision ought never to be attempted except in childhood or youth, and never unless, with disease still progressing, the joint-surfaces are hopelessly displaced (a very rare occurrence), or the surgeon, on a careful review of all the symptoms, has strong reasons for concluding that natural recovery is impossible. When the operation is once decided upon, it should not be delayed till the patient's health has given way, but should be performed at once.

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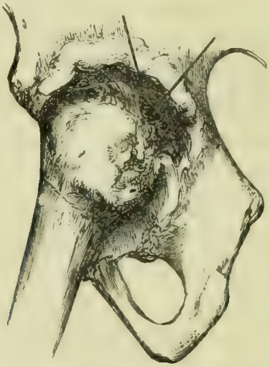
* Mr. H. Lee has related a very interesting case in which excision of the hip was attempted, but as the disease in the femur was found too extensive, amputation was performed. There was a large pelvic abscess, which was laid open by freely removing the diseased bone forming the floor of the acetabulum. The patient, a boy aged fourteen, rapidly recovered. (*St. George's Hospital Reports*, vol. i. p. 149.)

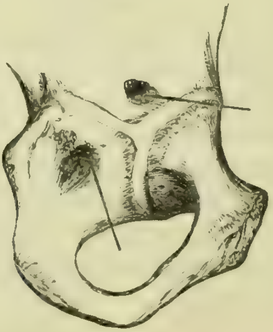
The recovery after excision of the hip-joint is very complete, as far as the movements of the limb are concerned, though the shortening is generally, I think, greater than after the spontaneous cure. The preceding figures (374–378) were taken from a lad in whom I excised the hip about five years ago, having removed the floor of the acetabulum so freely that three fingers could be passed through it. Every movement of the limb is perfectly free, and almost as extensive as in the natural condition.

Fig. 378.



The hip-joint after successful excision, showing the ligamentous cord by which the stump of the femur is united to the pelvis.

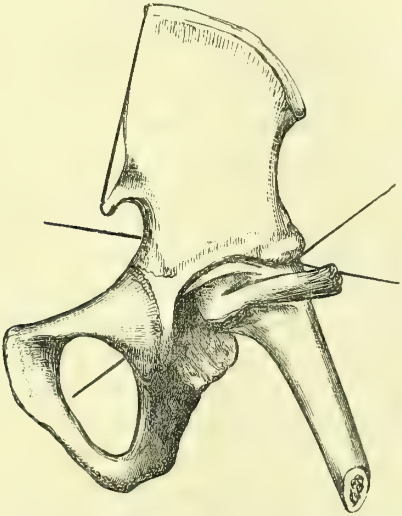
Fig. 379.



From the same case, showing the inner openings of two old sinuses leading through the acetabulum ; their outer ends are marked by the bristles in fig. 378.

Bony ankylosis very rarely takes place. I have never seen it. The annexed illustrations (Figs. 378–380), taken from a case where I had excised the hip successfully in a patient who died of another disease, show the usual condition of parts. They correspond closely with the state of things in an interesting preparation in the Museum of the Royal College of Surgeons, taken from the patient, in whom the operation was first performed, by Mr. White.

FIG. 380.



Another view of the same preparation, showing the end of the femur drawn up into the (enlarged) acetabulum by the tendon of the psoas.

Excision of the knee has been practised more frequently than that of any other joint, except the elbow; but the opinions of surgeons are by no means so unanimous on the former subject as they are on the latter; for whereas no one denies that amputation of the arm should only be resorted to in exceptional cases of disease and injury of the elbow, many hospital surgeons, in this city at any rate, think that amputation is advisable in the majority of the affections of the knee. There are many reasons why excision should be less successful in the knee than in the elbow. Firm bony ankylosis is required in the lower extremity; the treatment involves many weeks of strict confinement to one position; the surfaces of bone sawn through are very large; the cavity of the wound is badly situated for union; the epiphysial lines are near, and if trenched upon in young subjects, the growth of the limb will, in all probability, be checked; the operation is more severe than excision of the elbow; and, finally, the advantage of preserving the foot, although considerable, is far less than that of retaining the hand. It is not likely, therefore, that this operation will ever come into such favour as that on the elbow; still, though it has been vehemently decried, and though its general adoption has possibly been equally retarded by its having been vehemently overpraised, it will always hold a place among the resources of operative surgery for the treatment of appropriate cases.

The acceptance which this operation has met with is not due to its lower rate of mortality. It has been clearly shown by the statistics collected by Dr. Hodges,* that in general practice the mortality has been about one-third; a far higher average than that after amputation at the lower third of the thigh for chronic disease of the knee; and from what I can learn of the statistics of metropolitan hospital practice, I believe the same rate of mortality has prevailed.† But this only imperfectly represents the ill-success of the operation; for if to those who have died we add those whose limbs have been amputated, or have remained useless, we shall find that the failures after the operation at least equal the successes. In spite of this, however, it is the universal conviction of hospital surgeons that the operation ought to be introduced into practice. This conclusion must rest upon other considerations than those of the mere mortality after amputation and excision. It is not very probable that excision of the knee will ever be less fatal than amputation. There is no conceivable reason why it should be so. It is sometimes said that the hæmorrhage is less; but I am far from convinced of this. The blood *shed* in an amputation is always greater than in excision; the blood *lost* is frequently less, for in a well-managed amputation the blood which gushes out is only that which was circulating in the amputated part, and little else is really lost to the system. In excision the operation is often a bloody one (though sometimes not so), and secondary hæmorrhage is by no means rare. Then it is said that the wound is smaller than in amputation; but though the *surface* of the wound is smaller, its cavity (which is at least as important) is larger. The immediate shock, as far as I have seen, is generally considerable; quite as much so as in amputation.* The surfaces of bone exposed are very large, and the union of this great compound fracture, and the filling up of the large cavity left by the operation, call for considerable reparative power, and entail dangers from which amputation is exempt. But what has really brought excision of the knee into practice, and has compensated for the failures induced by its indiscriminate adoption in all kinds of cases, is its striking success in cases which are fitted for it; and it is, therefore, to the discovery of rules whereby such cases can be diagnosed, that the efforts of those who wish to promote this operation should be directed. The space which an adequate discussion of this matter would require not being here at my command, I must be excused for expressing summarily what I believe to be the correct indications for the performance of excision of the knee, as far as our present experience will enable us to lay them down.

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* Op. cit. pp. 142-8.

† See *Brit. and For. Med.-Chir. Rev.* July 1862.

Excision of the knee should never be performed in elderly persons.† They have not usually the requisite reparative power; and the advantage over amputation is not sufficient, even in the most favourable case, to balance the increased risk. There are many reasons also against performing the operation in very young children:‡ such as the probability of recovery without operation, if the suppurating joint be kept in a good position and freely opened; the risk of checking the growth of the limb by excision; the great probability that the joint-disease is but a symptom of constitutional mischief, in which case excision would do no good. No excision of the knee ought to be undertaken in a patient in whom there is any good reason to suspect, far less any evidence of the existence of, phthisis or any other constitutional affection. Had this simple dictate of common sense been more strictly adhered to, many of the deaths which now give so gloomy a complexion to the statistical reports of excision of the knee would have been avoided. Excision for disease should be exclusively confined to cases in which the disease is in a chronic condition. In acute abscess the operation is inadmissible. In all cases where sinuses exist, leading for any considerable distance, and generally whenever the disease is of very long duration, excision should only be undertaken as an exploratory measure, and everything should be in readiness for amputation, if the softened condition of the bones should render the latter operation necessary; as will very probably be the case, even if no part should be found absolutely carious or necrosed. In deformity the result of old disease, if the disease have entirely subsided, orthopædic measures will most probably succeed; but if the case appears beyond their reach, no grave operation ought to be undertaken, except at the express instance of the patient; or, if a child, of his parents. The operation itself has its own peculiar difficulties and dangers in such cases: but, as a general rule, *opérations de complaisance*, as the French call them, should never be pressed on the patient. Excision for injury, or primary excision, is very rarely required, or justified, in civil practice;* and in military practice (as stated above, vol. ii. p. 232) it is rarely feasible. The little evidence that we possess at present appears to show that the risk is greater than that of primary amputation. Primary excision ought not to be undertaken except in young subjects, and not in them except in those rare cases where, along with an amount of injury to the joint which renders preservation of the limb without operation hopeless, there is at the same time no such extensive wound, and no such injury to the main vessels, as to necessitate amputation; and even in these rare cases it will always be doubtful whether the injury to the bones is limited to the neighbourhood of the wound, and therefore the operation is always to be regarded as an exploratory proceeding, which may terminate in amputation.

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* I am informed by Mr. Henry Smith that in more than one fatal case at King's College Hospital death has been attributed to the shock of the operation.

† Speaking generally, and with due allowance for exceptional cases, I mean in persons above the age of forty-five.

‡ I do not mean to proscribe the operation in early childhood; in fact I have often operated on very young children; but I regard the best age for this operation to be about puberty.

The conclusion from all this appears to be, that the cases suitable for excision are those of incurable injury or disease of the knee, in which all the circumstances, both constitutional and local, are most favourable; in which the patient is in the prime of life, and free from visceral disease; and in which there is reason for hoping that the lesion has not spread beyond the epiphysial ends of the bones.

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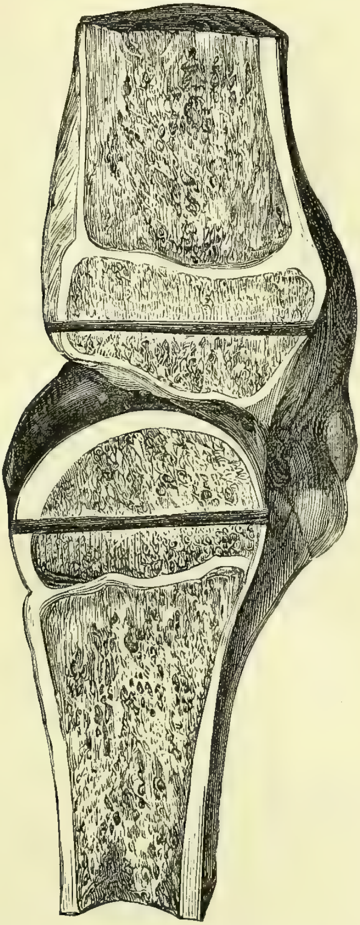
* Mr. Canton has published two cases in which he performed excision of the knee for injury; or perhaps, more strictly speaking, for abscess following injury.

The operation is thus performed: an incision should be made from the back part of one condyle to the back part of the other, passing across the front of the limb below the patella, and

Fig. 381.



A section made through the femur and tibia in a child aged five years, to show the position of the epiphysial lines and the point at which the section ought to be made in excision. If the section be made above the trochlear surface of the femur, at the level of the dotted line, the whole epiphysis will be removed. In the tibia, the whole articular surface may be removed without risk.

slightly convex downwards. It is seldom necessary to make any other incision into the skin;* but if there is much thickening about the soft parts, perpendicular incisions may be made at the ends of this so as to form the **H**-shaped incision, which used always to be employed in this operation. The ligamentum patellæ is to be divided in the first incision; then the soft parts

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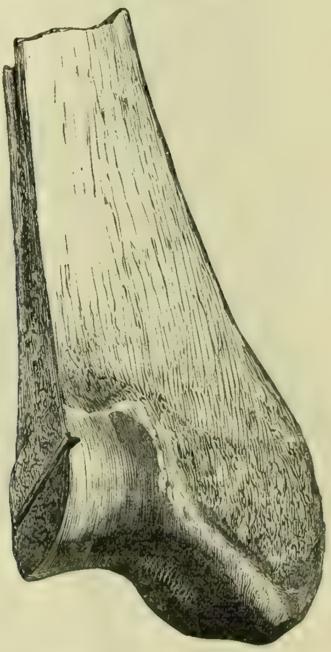
* Some surgeons prefer to make a long elliptical flap from the front of the limb, including the patella. I myself do not ordinarily use this method, as it

FIG. 382.



The same femur, shown in an anterior view, to mark the level at which the saw ought to be applied.

are to be thrown back from the patella and the end of the femur, and the patella is to be removed.* The joint is now to

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makes a larger wound, and renders it somewhat more difficult to deal with the patella. It may, however, be necessary when there is much swelling.

* It is my invariable rule to remove the patella, and this is, I believe, the usual practice. I can see no use in the bone if left, and much risk of recurrence of disease. (See also Swain, 'On Excision of the Knee-joint,' p. 73.) Dr. Patrick Heron Watson, on the other hand, counsels its preservation, when possible, for the following reasons: '(1) That its removal is unnecessary in most cases; (2) that its presence in the flap bears up the soft parts from the line of incision, and, without preventing consolidation, helps to keep them away from the cut margin of either osseous surface; (3) that its removal occasions more bleeding; and (4) that the hollow left after its removal from the centre of the long flap leaves a hollow cavity, in which matter bags, and requires a separate incision to drain it efficiently.' ('On Excision of the Knee,' p. 76.) If

be freely opened by cutting at the sides of the condyles, so as to sever completely both lateral ligaments; and then the knife is to be carried round the posterior surface of the end of the femur, care being taken in doing this to thrust the femur out of the wound as much as possible, by an assistant forcibly flexing the limb, and to keep the edge of the knife directed towards the bone, and guided by the finger, so as to avoid the popliteal artery, which here is separated from the bone only by some fat and loose tissue; and, in sawing the bone, it may be advisable, if the femur have not been very completely cleaned, not to pass the saw entirely through the osseous tissue, but rather to break than to cut the outer lamella at the back, by using the saw as a lever. The level at which the femur is to be divided should be carefully borne in mind in operating on children. I have repeatedly seen the surgeon take away the whole epiphysis and a part of the shaft from mere want of care, having forgotten, or omitted to ascertain, whereabouts this line is situated. Figs. 381–382 show its true position, and will prove that in any case of excision in which the whole cartilaginous surface of the femur is removed, the shaft will be trenched upon. The end of the femur having been removed, the head of the tibia is to be cleaned and sawn horizontally, care being taken in young persons to keep close below the cartilaginous surface, so that the epiphysial line be not interfered with. In cases where there has been no dislocation, nor much alteration in the shape of the bones from previous disease, there is now usually no impediment to placing the limb in a straight position, with the bones in accurate adjustment. Otherwise they must be adjusted by taking off successive pieces from the end of the femur or tibia (if possible without going beyond the epiphysis); and in cases of old dislocation it is often necessary to sever some of the hamstring tendons. The parts should, in all cases, be adjusted in perfect position upon a splint, and the bandages firmly applied before the patient is moved or allowed to recover from the chloroform. If

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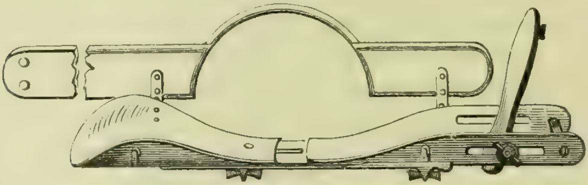
the latter assertion be well founded, it constitutes to my mind an additional objection to the use of the long flap in excision, rather than an argument for the preservation of the patella. None of the other supposed inconveniences of removing the patella will be found to be of any practical importance if the operation be performed with the simple transverse incision. As to the first assertion, it is a matter of experience. In my own practice, the removal of the patella has seemed in the great majority of cases not merely advisable, but necessary.

the femur appears at all prominent, a short splint should be applied in front in order to counteract the tendency of the leg to gravitate backwards (which is also assisted by the action of the flexor tendons); and it is at any rate a useful precaution to apply a long side-splint to the outer side of the limb, which can be discarded after the first few days, if it appears superfluous. I have found much comfort to the patient from suspending the whole apparatus in a 'Salter's swing.' It will of course be understood that the splints are interrupted and bracketed with iron at the seat of operation, so as to give access to the wound.

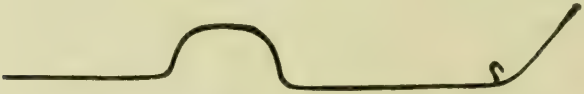
Fig. 383.



Splint for excision of the knee.

There are many other methods of dressing the wound and limb in cases of excision of the knee. Dr. Patrick Heron Watson warmly recommends the use of plaster of Paris (or plaster coated with paraffine externally, to render it less permeable to discharges), which he thus applies. Fig. 384 represents an iron rod, which extends from the groin to the foot, the upper straight end being at the groin, the arch at the site of the wound, the hook (for swinging the limb) near the ankle-joint, and the raised part running along the dorsum of the foot. Fig. 385 shows two forms of 'Gooch' splint, the former merely hollowed out on each side at the level of the wound and cut out at the lower part in a horse-shoe or stirrup form, to relieve the heel and tendo Achillis from pressure; the latter having also a piece above to be adapted to the innominate bone.

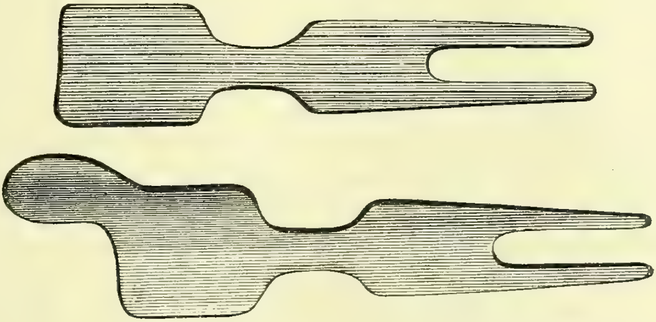
Fig. 384.



Dr. P. H. Watson's suspension-rod for excision of the knee.

'In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue, or hot paraffine, in the position which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin, at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an *open wove* roller bandage applied from the toes upwards, the site of the incision being alone left uncovered. The whole is then rendered immovable by means either of plaster of Paris applied by the hand, of the consistence of thick cream, or of paraffine, which, having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may be removed to bed, and the limb suspended from the running pulley of a Salter's swinging cradle, or from the roof-bar of the common iron-wire cradle.' (Op. cit. p. 19.)

FIG. 385.



Dr. P. H. Watson's splints for excision of the knee.

The advantages claimed for this method are the comfort the patient derives from being able to shift his position: the ease of transporting him from place to place (a great consideration in military practice); the facility of applying dressings to the wound; the permanence, simplicity, and facility of construction of the apparatus itself. My own experience of this treatment is limited to two cases, but these were sufficient to convince me of the reality of its advantages. The plaster of Paris dressing is in general use in this and other excisions by the German surgeons.*

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* 'Als wir hier mit diesem Verbande für Kniegelenksresectionen unsere ersten Versuche machten, zeigte sich derselbe so ausserordentlich praktisch und einfach, dass Herr Prof. Esmarch sich sofort veranlässt fühlte, das Princip auch für andere Gelenke zu verwerthen, und ist in Folge dessen dasselbe hier nicht nur auch für Fuss- und Ellbogen-Gelenk zur Anwendung gekommen, sondern auch mit bis dahin sehr befriedigendem Erfolg für eine Hüftgelenksresection.

'Die Patienten liegen, an welchem Gelenk auch die Resection ausgeführt

Mr. Butcher has recommended* a 'box-splint' for the after-treatment of this operation. This consists of two side-splints, the outer one extending from the axilla to below the foot, the inner from the groin to below the foot, jointed on to a back piece. The sides are let down to dress the wound. This is, as far as I have seen, a convenient apparatus when all goes well, but is less handy when complications occur, and is, on the whole, I think, inferior to the above-mentioned methods of treatment.

It is an essential element in the success of this operation not to be forced to disturb the limb at all for several days; hence the dressings should be most carefully applied at first. And for the same reason all bleeding vessels should be carefully secured, so as to avoid secondary hæmorrhage. The bleeding during the operation is often very free, from the enlarged articular vessels; and secondary hæmorrhage is by no means rare, and is a very unfavourable occurrence. The operation, especially when it has been a protracted one, which in cases of old dislocations it often is, is usually followed by a considerable amount of fever, subsiding with the establishment of a free suppuration; and then, in favourable cases, the work of repair commences by granulation and osseous union, as in compound fracture. In unfavourable cases, the bones become denuded and ulcerated in the suppurating cavity, the discharge is offensive, the wound unhealthy, fresh abscesses probably form, and the patient's health, instead of improving

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ist, ausserordentlich bequem, können vom ersten Tage an ohne Beschwerde jede Stellung einnehmen, und was uns noch besonders vortheilhaft erschienen ist, wir haben in allen Fällen . . . die Nachbehandelung ohne Verband zur Anwendung gebracht. Ich glaube wenigstens, das man nur diesem Umstande es zuzuschreiben hat, das man eine Kniegelenksresection von Anfang bis zu Ende behandeln kann, ohne jemals durch eine Spur von Geruch belästigt zu werden; ja, ich glaube sogar, das man das auf keine andere Weise erreichen könnte. Dabei ist der Verband und das Glied fast beständig rein, weil der Eiter aus der Wunde hervorgedrungen, über das Glied und die durch Firniss vor Imbibition geschützte Schiene sofort herablauft und in das untergesetzte Gefäss tropft.'—From Dr. Zerssen's *Graduation Thesis* at the University of Kiel, in 1868. I may, however, add that even more rapid cures and more complete absence of foul odour or profuse suppuration have been attained by the method introduced into practice by Professor Lister (see above, in the essay on AMPUTATION). My colleague, Mr. Pick, treated a case of excision of the knee, in a child, by this method recently, in which the whole wound healed in a fortnight. The two methods may of course be combined.

* *Operative and Conservative Surgery*, p. 142.

from the removal of the disease, shows a tendency to decline. Under these circumstances, chloroform should be administered and amputation performed, if on examination it proves necessary.

The process of recovery is usually a slow one. In Dr. Hodges's tables, already referred to, the duration of the treatment in 48 cases in which the patella was removed is stated to have been 225 days; and in 38 cases in which that bone is believed to have been left, 255 days; or, roughly speaking, the average duration of treatment was about eight months; and in many of the cases which afterwards turn out the most successful, sinuses remain open, and the limb is in a state which cannot but cause anxiety for many months after formal treatment is discontinued.* In some exceptional cases, indeed, matters go on much more rapidly than this, and the recovery is completed as soon as (indeed, it may be that one or two have recovered sooner than) after amputation; but, as a general rule, the time required for recovery after excision may be taken at about four times as long as after amputation. In fact, I think we are taking a view very favourable to excision, if we say, that every month after the operation advances the cure only as far as a week would after amputation.

What is the value of the limb which is obtained by this operation, at the cost of such increased risk and so much additional suffering? Unfortunately, this is a question, the answer to which has been so distorted by the rash and exaggerated statements of the indiscriminate advocates of the operation, that no impartial person can profess to be able to solve it. I have seen, in many cases, most excellent limbs left after excision; far superior both for appearance and utility to any apparatus which could be manufactured after amputation, and still more to the ordinary wooden leg: and it is on account of the occurrence of such cases that I believe excision ought to be practised upon the most favourable cases of disease of the knee; but I utterly disbelieve the accounts which have been published, resting upon statements in newspapers and periodicals, of cases, many of which had not recovered from the operation, while in a great proportion the sinuses were still open, and the patient in about an equal chance of saving his limb or losing it. No case is to be accepted as a successful one of excision of the knee, without *precise* information as to the following facts: Whether the wounds were all closed; whether the union was so firm as no longer to permit any motion; whether the patient could walk, and, if so, with or without apparatus; and what were the respective measurements of the limbs. It is true, that to have waited long enough to satisfy these queries would have somewhat delayed the appearance before the world of some brilliant cases, and perhaps have condemned many of them to perpetual obscurity; but, on the other hand, it would have made the information, when it did appear, useful and trustworthy, instead of, as at present, either useless or deceptive.

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* In a series of eight successful cases, all of them in children, at St. Thomas's Hospital, for the notes of which I am indebted to Mr. Allingham, the average duration of treatment was 206 days. From the notes of 50 successful amputations of the thigh, at St. George's Hospital, I find that the average stay in hospital was 53 days. This includes patients of all ages. Children and young persons, such as are alone the subjects of excision, recover from amputation more rapidly than the average.

As far as Dr. Hodges could discover, from the data furnished by published accounts, out of 208 cases of excision, 102 failed utterly, as proved by death or amputation; and of the remaining 106, there was reason for thinking that in 65 cases the limb was useful, and in 14 partially or entirely useless; 27 being left quite doubtful: but from the nature of such accounts this conclusion cannot be a very confident one. Out of 19 cases occurring at St. Thomas's and St. George's Hospitals together, of which I have trustworthy and sufficient details, the limb was useful in 10 cases; but 9 of these were children.

The results of English practice, as far as he could ascertain them, from the invention of the operation down to a very recent period (not expressly specified) are thus tabulated by Mr. Swain in 1869:

	No. of cases	Recoveries	Deaths	Amputations	Recoveries	Deaths
Recorded in Price's book up to 1865	316	240	76	39	30	9
Collected by Mr. M'Cormac . . .	74	49	25	11	7	4
Tabulated by Mr. Swain himself .	82	67	15	4	4	0
	472	356	116	54	41	13

Thus we have 472 cases, with a mortality of 116 = 24·57 per cent. Of the 356 who recovered from the immediate effects of the operation, 54 underwent subsequent amputation (13 of them dying), leaving 302 with useful limbs.*

I give this table as Mr. Swain gives it, and cordially agree with him in his low estimate of the value of such statistical information. Such tables can in fact prove very little. They do indeed show that the mortality has diminished: but whether this has arisen from improved surgery—that is from a better style of operating and after-treatment—or from a more indiscriminate application of the operation to cases of slighter disease which need not have been operated on at all, but in which the patients will of course be more likely to survive operation (and which I would call deteriorated surgery), neither is nor can be shown by statistics. It is also a somewhat suspicious feature in Mr. Swain's table that all the 302 recoveries are claimed as being with useful limbs. If the information had been at all adequately full, there would surely have been a category of recoveries with the limb more or less useless.

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* *Swain,* op. cit. p. 64.

Another very serious consideration in cases which recover with useful limbs is, whether that usefulness will be permanent. It is now a well-known fact, that the utility of the limb in many cases in which it seemed perfect at first has been destroyed by subsequent changes. In adults, the union, although it has appeared quite firm, sometimes proves not to have been so, and the limb bends under constant use, and yields to the power of the flexor muscles, until the foot no longer touches the ground, and the whole extremity becomes an incumbrance instead of a support. Sometimes it bows outwards or inwards, but with the same general result. Occasionally disease recurs, after a shorter or longer interval of apparent health, either spontaneously or as a consequence of some accidental injury or over-exertion.

Suspension of growth after excision of the knee in childhood is very liable to occur; and is usually caused by removal of the entire epiphysis,* with encroachment on the shaft of the femur, and possibly of the tibia also. I have already spoken of the precautions which ought to be taken in operating on children to avoid this, and I believe that in most cases the disease can be entirely removed and the epiphysial line left intact. But allowing that shortening occurs even to a very great extent, the limb may nevertheless be very useful. For a proof of this I would refer the reader to various cases published by myself and others which have been quoted by Mr. Swain,† and for the details of which I have not space here, and to some admirable remarks by Sir W. Fergusson in the sixth of his lectures *On the Progress of Anatomy and Surgery*, illustrating the value in these cases of the preservation of the healthy leg and foot.

I recently saw a case in which I had operated eight years before, and where I had been obliged to remove the femur higher than the epiphysial line,‡ and in whom therefore there had been progressive shortening. The patient has now attained the age of twenty-two; his growth appears complete; all irritation in the site of the wound has long since disappeared; the shortening now reaches six and a half inches; it is compensated partly by a dropping of that side of the pelvis to the extent of about two inches; the heel of his boot measures four inches in height; he walks with a slight limp, can walk any distance, and at the rate of over four miles an hour, and has done twenty-five miles in a day without fatigue. The muscles of the thigh on the side operated on are much wasted.

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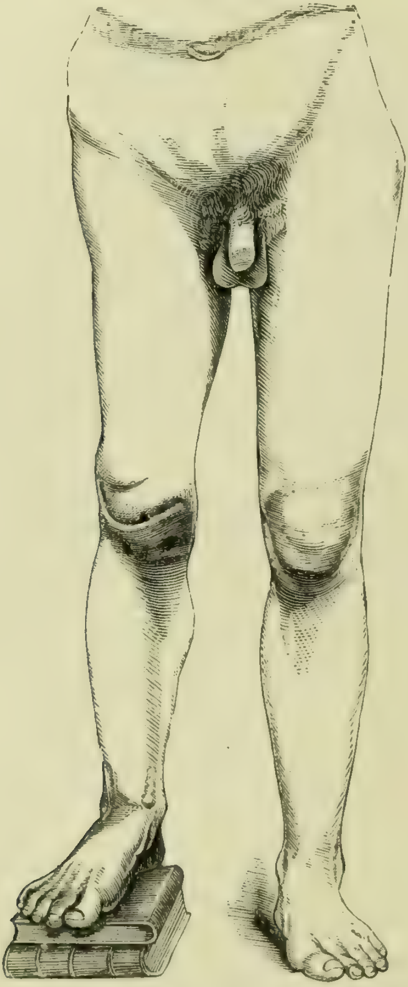
* Suspension of growth has, however, been noticed in one case at least, under Mr. Syme's care, where the epiphysial lines appear to have been left intact.

† Op. cit. pp. 141 to 148.

‡ *Surgical Treatment of Children's Diseases*, 2nd ed. p. 486.

FIG. 386.



Result of successful excision of the knee. (From a photograph.) To show the dropping of the pelvis on the affected side, by which the shortening is partly compensated, and the atrophy of the muscles of the thigh which follows on disuse of the knee-joint, while those of the leg are little affected.

The repair after excision of the knee may be illustrated by reference to the preparation figured here. It is true that this was not a completely successful case; but repair is very far advanced, and had it not been for the visceral disease, it would, I doubt not, have been completed. As the case was under my own care, I may add that it serves also as an ‘examplar ad evitandum,’ showing the deformity which is sometimes, in spite of all ordinary care, introduced into the union by displacement of the bones of the leg, and which both renders the limb less straight and comely, and doubtless tends to weakness in the union and subsequent displacement.

FIG. 387.

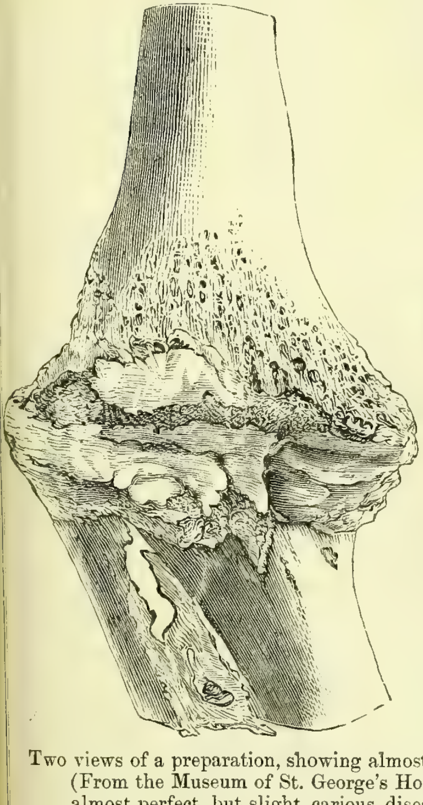
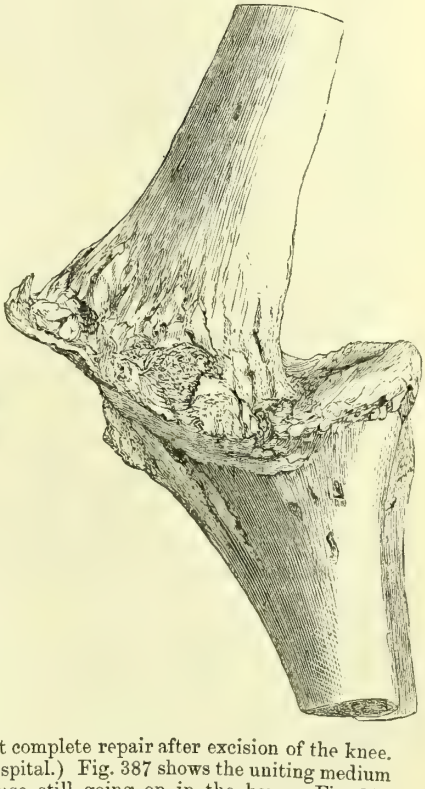


FIG. 388.



Two views of a preparation, showing almost complete repair after excision of the knee. (From the Museum of St. George's Hospital.) Fig. 387 shows the uniting medium almost perfect, but slight carious disease still going on in the bone. Fig. 388 shows the tilting backwards of the bones of the leg, or ‘riding of the femur,’ which is so liable to occur after this operation. The patient, a girl about the age of puberty, had nearly recovered from the operation, when signs of renal disease showed themselves, and she gradually sank.

If the limb be simply bent in consequence of soft union, the only treatment required is to straighten it under chloroform, and keep it straight in a carefully-fitted splint for some months, with due attention to the general health, the patient being put in good pure air, and allowed to take moderate exercise upon crutches. When disease is present in the bones, it becomes a question whether the diseased bone can be removed, or whether the limb should be amputated. Some surgeons have even proposed the complete re-excision of the false joint by an operation similar to the original one—a proposition highly worthy of consideration if the patient has attained his full growth and is in good health, and the shortening left by the first operation is not great. Such re-excision must, however, always be proposed to the patient as an exploratory operation, which in many cases will have to terminate in amputation.

Excision of the ankle. In the last edition of this essay I spoke discouragingly of the operation of excision of the ankle, not having at that time had any personal experience of the operation in my own practice, though I had seen many cases under the treatment of others, and those very eminent surgeons. My individual experience is still very limited (in fact, the operation is one which is rarely indicated), but it has been very satisfactory, being confined to two cases which recovered rapidly, and, as I believe, completely. The operation is one on which a wide difference of opinion prevails. There are many surgeons who have never practised or witnessed the operation, many who are entirely opposed to it on principle, believing amputation at the ankle-joint preferable; others who, after a limited and unsatisfactory experience of it, have abandoned it; and, lastly, others who, like myself, believe that it is very advisable and advantageous in appropriate cases, but believe, also, that those cases are rare. The cases to which I allude are those in which the disease is of traumatic origin, and the patient in the vigour of life, unaffected by any constitutional malady. In such cases the inflammatory softening, or suppuration, does not usually extend far from the neighbourhood of the joint originally implicated, and after the removal of the diseased bone, the parts take on a healthy action, and become rapidly consolidated. In strumous disease, on the other hand, inflammatory softening, if not diffused suppuration, often exists in the tarsal bones or the bones of the leg, in parts not exposed to view in the operation: and in patients labouring under general constitutional affections, the parts operated on, instead of consolidating, usually soften, and after a long and exhaustive suppuration the bones are found carious, leaving no resource except amputation, and that under very unfavourable circumstances. Again, as to the extent of the local disease. A case, to be strictly a favourable one for excision of the ankle, ought to be one in which the lesion is limited to the epiphysial ends of the bones of the leg on the one side, and to the astragalus on the other.* Still, cases are on record in which most extensive excisions, involving the ankle-joint and more or less of the tarsus, have been followed by complete success,† but it must always remain a question in any given case whether the prospect of complete and speedy cure by amputation ought not to outweigh the doubtful chance of preserving a mutilated foot, which after all may be of little use, even should it continue free from recurrence of disease.

With respect to excision of the ankle for injury, I need say little as to the use of the operation in military surgery, since the question has already been treated in the essay on GUNSHOT WOUNDS, vol. ii. p. 234. The successful experience, however, of Langenbeck in this operation, besides its special bearing on military practice, is also important in considering the general question of the advisability of attempting resection in preference to amputation in severe and incurable injury of the ankle. M. Ollier's experience, though not so extensive, is perhaps still more to the purpose in this respect, that it is gained entirely in civil practice.

He reports (loc. supr. cit.) that he has practised resection three times for comminuted fractures of the lower ends of the bones of the leg. In one case—a man 49 years of age—about one-third in length of the tibia was removed (12 centimètres = about 4 inches). The reproduction was not complete, but the patient recovered sufficient power to carry on his trade of a cooper. In the second case, 7 centimètres in length of both bones was removed The patient, a midwife, was at the time of the report (length of time after operation not stated) able to walk with a stick and to attend to her business. In a third case, the patient died of cerebral complications produced by the same injury. A still larger portion of bone (16 centimètres) had been removed, and all was going on well as far as the operation went. M. Ollier also refers to another case under the care of MM. Jambon and Aubert (of Mâcon) where 10 centimètres of the tibia were removed; the patient had completely recovered, could walk ten miles, and dance for hours together.

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* M. Ollier would still further restrict the application of this excision. He says: 'C'est seulement pour les ostéites épiphysaires des os de la jambe, avec propagation de l'inflammation suppurative à l'article, que je crois cette resection nettement indiquée.' (*Des Resections des grandes Articulations*, p. 26.) Lyon, 1869.

† In one case referred to by Dr. Hodges, the ends of the tibia and fibula, the whole of the astragalus, part of the os calcis, and the three cuneiform bones, were removed; in another the end of the tibia, the astragalus, scaphoid and two of the cuneiform.

Mr. Hancock, in his lectures at the Royal College of Surgeons in 1867,* referred to numerous cases in civil practice in which excision of the ankle (or at least of the extremities of the bones of the leg) had been practised successfully on account of injury. Nineteen successful cases are referred to by Mr. Hancock, (one of which is of peculiar interest, inasmuch as the operation was practised on both sides), and he mentions that 'Heyfelder gives 26 examples of this operation, of which 5 died, and 1 suffered consecutive amputation; while Jaeger, on the other hand, records 24 cases, 23 of which proved successful, and 1 died.'

In almost all cases of excision for injury, the operation has been rather a resection of the fractured ends of the tibia, fibula, or both, than a complete excision of the ankle.

These facts appear to demonstrate that in complicated injuries about the ankle, resection may be performed with good hope of success if the patient be healthy, and if the after-treatment be judicious.

We are not in a position to lay down rules for the preference of excision over the expectant treatment, on the one hand, or amputation on the other. 'Each case,' as Mr. Holthouse says,† 'must be studied separately, and the means adapted to the circumstances present.' But I think that we may conclude, generally, that excision is preferable to amputation in young patients of healthy constitution and habits, and that it is preferable to the expectant treatment in cases of great comminution of bone associated with comparatively slight injury to the soft parts.

With regard to the operation itself, I cannot do better than quote Mr. Barwell's description of the operation, as originally devised by Mr. Hancock, and which is, as far as I know, the best operative procedure for the removal of the entire joint—that is to say, the ends of the bones of the leg and the articular surface, or, if necessary, the whole of the astragalus. 'The foot is first laid on its inside, and an incision is made over the lower three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle, and runs downwards and forwards to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forwards; the fibula, about two inches above the malleolus, is sufficiently cleared of soft parts to allow cutting forceps to be placed over it; and the bone is then nipped in two and carefully dissected out, leaving the peroneus longus and brevis tendon uncut. The foot is now to be turned over. A similar incision is made on the inner side, the portion on the foot terminating over the projection of the inner cuneiform bone. The flap is to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament is then to be severed carefully, close to the bone; and now the foot is twisted outwards, and the astragalus and tibia will present at the inner wound. A narrow-bladed saw, put in between the tendons into the inner wound, projects through the outer. The lower end of the tibia, then the top of the astragalus, may be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound may be closed with sutures, except that part opposite the breach of osseous matter; the leg and foot placed on a splint with a foot-board, and cold water applied.'

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* *Lancet*, vol. ii. 1867, p. 121.

† INJURIES OF THE LOWER EXTREMITY, vol. ii. p. 922.

Dr. M. Buchannan has also described * an operation for excising the ankle-joint, by making a curved incision over the external malleolus, removing this process with the bone forceps, dislocating the joint by inverting the sole of the foot, and thus obtaining access to the diseased bones without dividing any important parts, the peronei tendons being the only structures necessarily divided. This proceeding is merely a portion, as it were, of the one described by Mr. Barwell. It cannot give so free an access to the bones as is obtained by the former; but it may be adopted in cases where the end of the tibia does not require entire removal with the saw. The operation may, therefore, be commenced by making merely the incision on the outer side; and then, if it be found necessary, that on the inner side may be added.

Langenbeck and Ollier have preferred the subperiosteal method of operating, and for the removal of large portions of bone in recent injuries there can be no question that this

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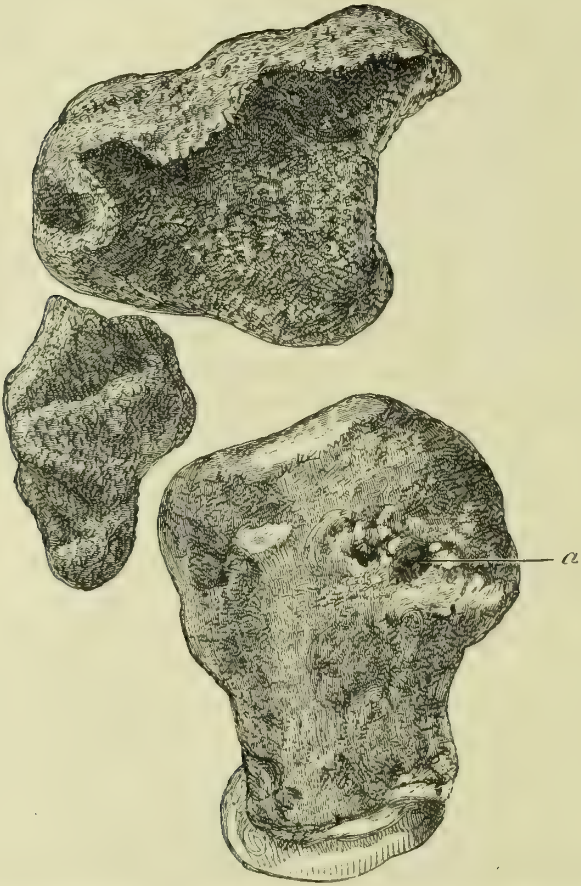
* *Glasgow Medical Journal,* vol. ii. p. 1.

method should be preferred. In disease I think the method is of little consequence, because I do not believe that any large quantity of bone could be removed with success, unless for necrosis, when the periosteum would probably separate of itself. If only a small slice of the bones of the leg were removed, I should think it a matter of little consequence whether reproduction occurred or no. No express directions are needed for the subperiosteal operation beyond those given at p. 662.

Fig. 389.



Bones removed in excision of the ankle, showing the ends of the bones of the leg and the upper surface of the astragalus.

I have elsewhere* pointed out the advantages which are to be derived from the removal of the entire astragalus in cases where that bone is at all extensively affected. In fact, whenever the disease appears to have commenced in the astragalus, I think it is better to remove the whole bone; and still more is this the case if the sides of the bone are ulcerated and freely exposed, since in such circumstances the lower surface will also probably be found affected. Such was the case in the instance to which I refer, and from which Figs. 389–390 are taken. They show the implication of all the articular surfaces of the astragalus, except that of its head, in the ulceration. The removal of the whole astragalus requires free incisions, and is somewhat laborious, but it affords complete access to the upper surface of the os calcis, which can be removed, if necessary, with the chisel, and even to the anterior part of the tarsus, if it should be judged necessary to deal with this. In the after-treatment, perfect rest of the foot is essential until the parts are somewhat consolidated. When this is effected, the foot may be supported on a splint, and the patient be allowed to go about, resting the knee on a wooden leg. I have hitherto treated my patients in the way which is common, in compound fracture of the leg, at St. George's Hospital, viz. by confining the foot and leg in Assalini's fracture-box, dressing the wounds at first with carbolic acid on Mr. Lister's plan, and at a later period—

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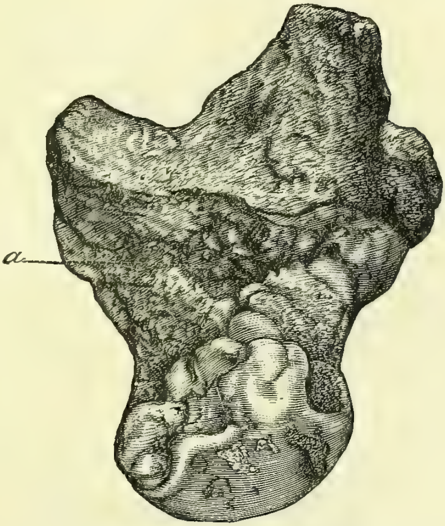
* *St. George's Hospital Reports,* vol. iv.

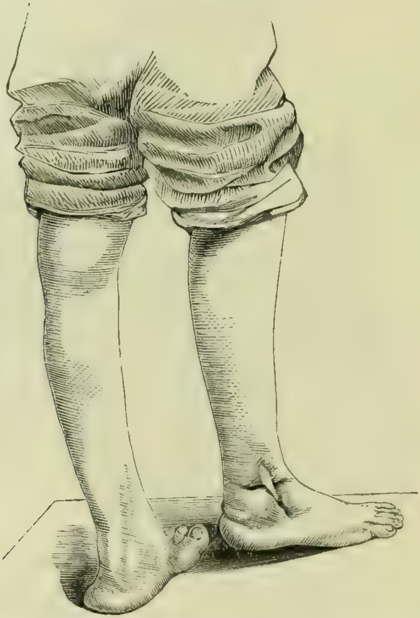
Fig. 390.



The lower surface of the astragalus. The letter *a* in this and the previous figure shows the pit made in the astragalus by the grasp of the lion-forceps.

when suppuration has been fairly established, and the acute inflammation has subsided—with oakum. Langenbeck insists strongly on the advantages of the plaster of Paris splint in these cases, as in so many others, and I am informed by Dr. Patrick H. Watson that he has combined with the gypsum bandage a suspension rod similar to the one which he uses for excision of the knee (see p. 702), but without any splint. Professor Esmarch, of Kiel, has also adopted Dr. Watson's plan, and both surgeons have found the results very satisfactory.

Fig. 391.



In cases of successful excision, the limb is very much superior in usefulness to any stump which can be formed, whether by Syme's or any other method of amputation.

One of these successful cases was exhibited at the Pathological Society in 1863. The excision had been performed, several years before, by Mr. Hancock. The foot was firmly ankylosed to the bones of the leg, and at a perfectly convenient angle. The shortening was but slight, and the man could walk almost as well as ever.

Fig. 391 was taken from a case in which I excised the ankle joint in 1869. His present condition is thus reported by my friend, Dr. Nicholls, of Chelmsford, near whom he resides: 'The operated leg is slightly shortened; all the wounds are healed; he walks, with the aid of a boot with irons, as much as half a mile, without inconvenience.' In this instance the disease was abscess of the lower end of the tibia, bursting into the joint. Only the upper part of the astragalus was removed, that bone being quite healthy.

An interesting case is reported by Dr. Murney in the *Dublin Quarterly Journal* for February 1870, in which the left ankle-joint had been completely excised eleven years before. The patient's state is thus described: 'He is now 27 years of age, muscular and strong, has enjoyed uninterrupted good health since he left hospital; is active and fond of walking, and considers the left is stronger than the right limb; does not use a stick; in progression there is a slight halt, but not more than is frequently observed from a corn. This, to the ordinary observer, would be attributed to a slight *in-turning* of the toes of the left foot, as when he walks the right foot is turned out, the left is placed straight. On examination, there is considerable deposit of new tissue between the bones which were cut. The foot is slightly extended. This makes the toes and anterior part almost of proper length, but the heel is 1½ in. higher than its fellow, which he remedies by placing a wedge-shaped piece of cork in the heel of his boot. The power of extension of the toes is as complete as in the opposite limb, and sensation is also perfect.

On the other hand, cases occur in which the result appears good for the time, but the success turns out to have been only temporary; the wounds, after healing, break out again, and local, perhaps combined also with general, disease reappears. I do not know that this is more particularly the case after excision of the ankle-joint than after any other of these operations.

Excision of the bones of the foot. In disease of the tarsal or metatarsal bones excision is often very successfully practised when the disease is limited to the os calcis behind, or to single bones of the metatarsus in front; but it is of more doubtful utility when the bones which are affected are those covered by the large common synovial membrane of the tarsus. These bones, both from their small size and from being portions of the same joint, are very liable to become involved in the same action, and thus it frequently happens that disease is only eradicated at one point to show itself some weeks afterwards at another, and the attempt to save the foot is often unsuccessful. But in favourable cases it ought to be made, since the operations involve little danger, and no confinement beyond what would be rendered necessary by the disease itself. Many surgeons prefer gouging out the whole carious cavity, leaving a shell formed of bone presumed to be healthy, and of the soft parts around; an operation sometimes dignified by the name of 'subperiosteal resection,' and described by M. Sédillot under the name of 'évidement de l'os.' The alleged advantages of this proceeding are, that the bone may be reproduced, and that the great tendons will be left in their natural attachments. I do not attribute very much importance to either of these considerations. No direct evidence, as far as I can discover, has been given that the natural bone will be reproduced after such gouging. I mean by 'the natural bone,' a bone which will fill up the place of the original bone, and have the same articulations; and by 'direct evidence,' the dissection of a foot in which this has taken place. The disadvantages are all of them summed up in the fact of the difficulty of being sure that the whole of the diseased bone has been removed. When the whole of the os calcis, of the astragalus, or of the first metatarsal bone, has been involved, except a small exterior portion of dubiously healthy bone, I have not scrupled to dissect out the entire bone without respect to the periosteum, and have seen no reason to repent having done so. The foot has been left in a very serviceable condition; and I much doubt whether the addition of a few detached pieces of bone to the cicatrix (which I believe would have been the entire result if the periosteum had been left behind) would have affected the usefulness of the foot in any way.

Excision of the os calcis is an operation which may often be practised with great advantage. Disease of the tarsus very commonly begins in the joint between the calcaneum and astragalus, and frequently spreads into the former bone; the affection of the latter being so superficial that the carious spot can be gouged away when the greater mass of disease has been removed. In these cases the central part of the calcaneum often perishes, leaving a large mass of necrosis enclosed in a thin-walled cavity of inflamed and softened bone. If now the whole bone, including this shell of softened bone, be removed, the patient makes a certain and speedy recovery with a useful foot; while if the loose portion be removed, and the shell scooped, he may, it is true, recover, and the heel may possibly be more firm, but the recovery is at least doubtful, and in the course of a tedious convalescence the health may give way, fresh disease be lighted up, and amputation become necessary.

Excision of the os calcis is thus performed. An incision is commenced at the inner edge of the tendo Achillis, and drawn horizontally forwards along the outer side of the foot, somewhat in front of the calcaneo-cuboid joint, which lies midway between the outer malleolus and the end of the fifth metatarsal bone. This incision should go down at once upon the bone, so that the tendon should be felt to snap as the incision is commenced. It should be as nearly as possible on a level with the upper border of the os calcis; a point which the surgeon can determine, if the dorsum of the foot is in a natural state, by feeling the pit in which the extensor brevis digitorum arises. Another incision is then to be drawn vertically across the sole, commencing near the anterior end of the former incision, and terminating at the outer border of the grooved, or internal, surface of the os calcis, beyond which point it should not extend, for fear of wounding the posterior tibial vessels. If more room be required, this vertical incision may be prolonged a little upwards, so as to form a +.* The bone being now denuded, by throwing back the flaps, the first point is to find, and lay open, the calcaneo-cuboid joint; and then the joints with the astragalus. The close connections between these two bones constitute the principal difficulty in the operation on the dead subject; but, as has been already stated, these joints will frequently be found to have been destroyed in cases of disease. The calcaneum having been separated thus from its bony connections by the free use of the knife, aided, if necessary, by the lever, lion-forceps, &c. the soft parts are next to be cleaned off its inner side with care, in order to avoid the vessels, and the bone will then come away. The flaps are to be closed lightly, with one or two points of wire-suture, over the large gap left by the excision.

This plan appears more convenient and less bloody than that recommended by Mr. Hancock and Mr. Guthrie, of making a flap from the heel and throwing it up, as done in Syme's amputation. Even if the diagnosis has been erroneous; if disease should become apparent in the astragalus or in the fore-part of the tarsus, when the bones are denuded, and so the surgeon should be led to amputate the foot, that operation could be easily accomplished by a slight extension of the incisions just described. In this way I have often removed the os calcis in a very short time, and without finding it necessary to tie a single artery. The filling up of so large a cavity is of course a rather tedious business; in most of the cases of which I have notes, recovery was not completed in less than three months; and probably the patient does not recover the power of putting the foot to the ground for another month or more. But when it is soundly healed, the foot is a very useful one; and I have seen children who could run, dance, &c. pretty nearly as well as with the natural foot.

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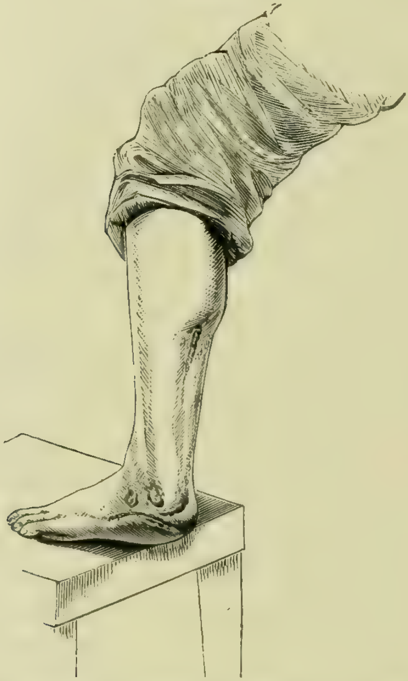
* I have always divided the tendons of the peroneus longus and brevis. They can, of course, be dissected out and held aside with a blunt hook, but I have not observed any bad effects from their division.

M. Ollier describes an operation by which the os calcis can be removed subperiosteally without the division of any tendons, except the tendo Achillis. An angular flap is made by an incision running horizontally along the lower outer border of the bone, and vertically along the outer border of the tendo Achillis. Then the periosteum and the parts above it, including the peronei tendons, are peeled off the bone. Next the attachment of the tendo Achillis and the periosteum are detached from the tuberosity of the os calcis. Then the joints are opened, and the inside of the bone is cleaned, and so its removal is completed. I have only practised this operation on the dead subject. It seems to me feasible enough, and worthy of trial; but my experience of the ordinary operation has been so favourable, that I have been the less anxious to adopt this modification.

Fig. 392.



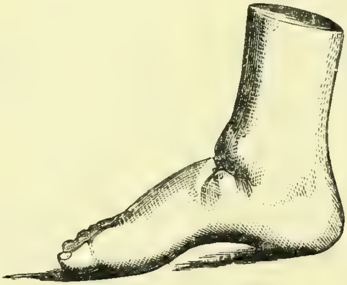
Drawing from the photograph of a patient in whom the os calcis, almost the whole astragalus, and a portion of the scaphoid bone, had been removed by Dr. Nicholls.

After recovery, the only mark of deformity in the foot is an elevation of the heel proportionate to the size of the bone removed. This can be judged of by Fig. 392.

Even when the astragalus is also diseased, the foot may be perfectly useful after the removal of both the diseased bones. Thus at the Medico-Chirurgical Society of Edinburgh, December 1869, Dr. Watson showed a cast taken recently from the foot of a boy in which he performed excision of the astragalus and os calcis, in July. The cast showed how a dense mass of tissue occupied the gap resulting from the operation. The posterior portion of the arch of the foot being gone, of course the patient could not expect to retain the spring of the foot; but in spite of this, not only was walking easily effected, but the foot, as was seen, presented a most seemly appearance.*

A somewhat similar case occured in the practice of Dr. Nicholls, of Chelmsford, the os calcis, almost the whole astragalus, and a portion of the scaphoid, having been removed in two operations. The patient can walk quite well and with a hardly perceptible limp; the appearance of the foot is shown in Fig. 392.

Fig. 393.



The foot after recovery from excision of the astragalus. In this case the scaphoid bone, which had become ankylosed to the astragalus, was also removed.

Excision of the Astragalus. The astragalus is easily removed by making a curved incision from one malleolus to the other, something like that made at the beginning of Syme's amputation. The ankle-joint is then to be laid freely open, and the whole upper part of the diseased bone thus exposed. Then the ligaments connecting it to the scaphoid are to be severed, and the bone is to be levered up, when the interosseous ligament connecting it with the os calcis will, if entire, be felt, and can be readily divided. All that is then necessary to complete the operation is to clean the back part of the bone, which should be done with care, in order to avoid injury to the tendons and vessels which lie near it. I have had several cases in children, and have seen one in an adult in whom a very useful foot was left; one of these is represented above.

The bone might also, no doubt, be removed by two lateral incisions similar to those used in excision of the ankle. This would avoid the injury to the tendons and vessels incidental to the above method; but would be more laborious.

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* *Edin. Med. Journ.* Jan. 1870.

No formal directions are required for excising the other tarsal bones. The soft parts are to be thrown aside by crucial incisions, radiating from the sinuses which lead to the diseased bone, and the latter removed; care being taken, in all cases where it is possible, to excise the whole bone with the articulating surfaces.

The metatarsal bone of the great toe is very often diseased; and from its large size disease may go on in its substance for a long period without affecting any other bone. In such cases, after a sufficiently patient trial of the appropriate constitutional treatment, with rest, it is proper to expose the disease; and if this is found to include the greater part of the bone, then the best course is to remove the whole, with both its articular surfaces. This may be readily done by making an incision over the whole length of the bone, joined by shorter perpendicular cuts in front and behind, and thus turning back small rectangular flaps including the whole length of the bone. It is better to commence by severing it from the cuneiform bone, as in dividing it from the phalanx the plantar arch will most likely be wounded, and the bleeding may prove somewhat embarrassing; whereas if the artery be not divided till the bone is removed, there is no difficulty in tying it. No splint is required. The great toe sinks down somewhat towards the tarsus, but the foot is as useful in progression as before.

Should single metatarsal bones in the centre of the foot be diseased, it is better to gouge away the whole of the diseased part; or if the affection seems too extensive, to amputate the toe, and dissect out the metatarsal bone from the posterior end of the wound.

The above are all the operations of excision which it seems necessary to describe particularly. Dr. Humphry has removed the condyle of the jaw (see vol. iv. p. 101); and the same surgeon on one occasion excised a fractured portion of the patella; but the superficial position of these bones, and the rarity of the operations, render any formal description superfluous.

The operations on the upper and lower jaw have been described in connexion with the surgery of that part of the body.

Total or Partial resections of long bones. When the entire thickness of a long bone is diseased, it may sometimes be advantageous to remove the diseased portion only. In this way portions of the ribs have been resected on account of caries, probably in order to avert the occurrence of pleuritic inflammation from the neighbourhood of the diseased bone ; an operation of some risk and very doubtful utility. Or portions of the shafts of the ulna, radius, tibia, or fibula, have been cut out, with a view of promoting the healing of ulcers that seemed otherwise incurable, or getting rid of an obstinate affection of the bone. Many operations for necrosis are also erroneously entitled resections of the shafts of the bones, when they are really only extractions of sequestra ; but in a few cases the necrosed shaft has been removed while yet connected to the living bone. Such operations, however, whether undertaken on account of caries or necrosis, too often result in failure. In cases of necrosis of a portion of the thickness of a bone, resection should very rarely be practised—perhaps we might say never, unless for the relief of inflammatory symptoms propagated from the diseased bone to neighbouring organs. Nor, in cases of necrosis of the whole thickness of the shaft, is it usually advisable to operate until the old shaft has separated from the new bone. No special directions are needed for these operations. The chief point to be attended to is to keep as close to the bone as possible, in order to spare not merely the tendons, vessels, &c. which may lie in relation with the diseased bone, but also the periosteum ; so that there may be as good a prospect as possible of the regeneration of the part removed.

Subperiosteal excision of the shafts of long bones. In cases of diffuse periosteal abscess, it will occasionally happen that the whole thickness of the shaft of the bone perishes, and becomes separate, or separable with very trifling force, from the adjoining bone, whether at the epiphysial lines, or at some part of the continuity of the diaphysis. In such cases the old practice was either to amputate, or to persevere in the expectant treatment until a sufficient periosteal deposit of bone had formed to restore the integrity of the shaft and support the muscular movements. I have in another essay * expressed my conviction that the latter plan of treatment should be abandoned, and that it is better, speaking generally, to remove a dead piece of bone whenever it is possible, without waiting for osseous reproduction. There are also cases, as I believe, where the subperiosteal resection of the whole shafts, or of large portions of the whole thickness of the shafts of the long bones, will much improve the patient's prospects of recovery, and in all probability obviate the necessity of amputation.

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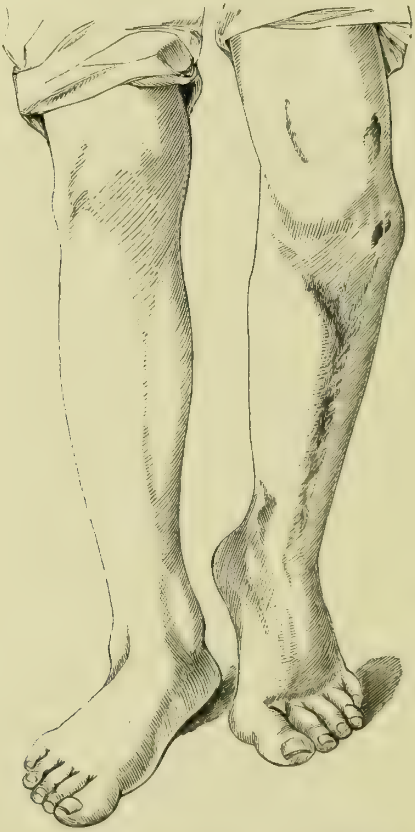
* Diseases of the Bones, vol. iii. p. 777.

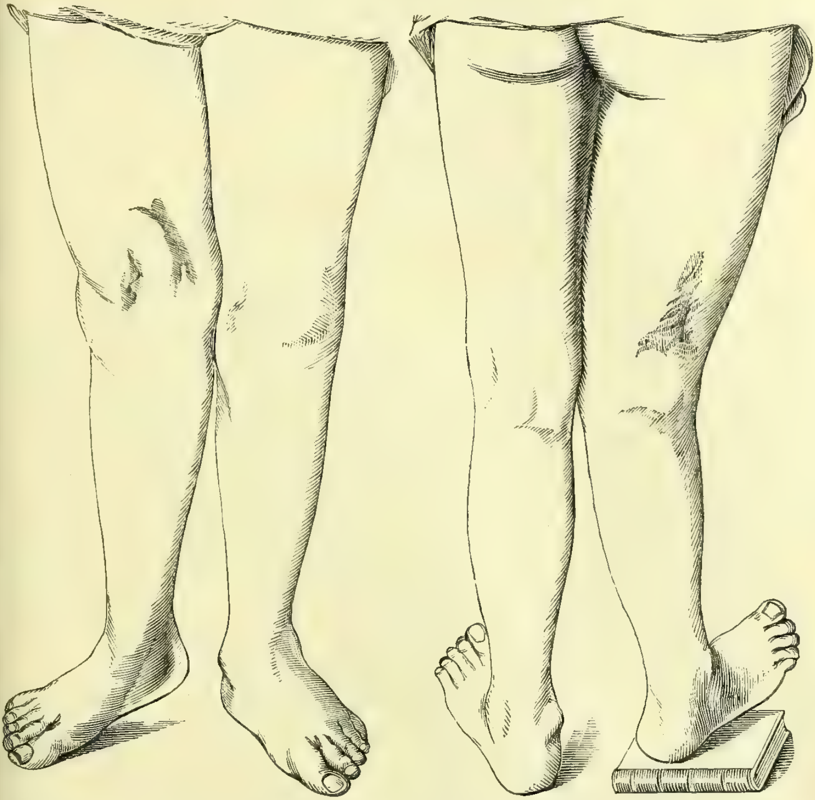
Fig. 394.



From a boy in whom the whole of the diaphysis of the tibia had been removed. To show the shape of the limb after reproduction of the bone, and the extent of the resulting shortening.

Many striking cases illustrative of the advantages of this operation have now been put on record. I may refer to a case of a boy, aged 10, in which I removed the whole diaphysis of the tibia, which had separated from both its epiphyses, one month after the commencement of acute periostitis; to another in which I removed a portion, 3½ inches in length, of the shaft of the femur about four months after the commencement of the disease and before any periosteal bone had formed;* to another in which Mr. Joseph Bell, of Edinburgh, resected a still larger portion of the femur;† to a striking case by Dr. Cheever‡ of Boston, U. S., of resection not only of the whole diaphysis, but also of the lower epiphysis of the tibia, at the age of 13, where nine inches of bone was removed, the ligaments of the ankle-joint divided, and the articular end of the tibia formerly dissected away from the fibula and astragalus, good motion resulting; and, finally, to three cases which may be found in M. Ollier's work, above referred to, under the care of Letenneur, Larghi, and Crus y Manso, in which the whole diaphysis of the tibia was successfully removed.

Fig. 395.



From a case in which three inches and a half of the shaft of the femur had been removed subperiosteally. The knee became ankylosed from the extension of suppuration into the joint. The first figure shows the amount of the resulting shortening, which is confined entirely to the femur. The cicatrix on the inner side is the mark of an abscess. The posterior view of the limb shows the position of the wound from which the bone had been extracted, and the deformity produced by the ankylosis.

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* *Surgical Treatment of Children's Diseases*, 2nd edit. pp. 391, 395.

† *Brit. Med. Journ.* May 2, 1868.

‡ *Surgical Cases*, by D. W. Cheever, M.D., p. 15; Boston 1869.

In all these cases, in which the whole thickness of the bone is removed for any considerable length, it appears to me, as far as I can discover, that shortening always ensues when the bone is solitary, as the femur; and almost, if not quite always, when it is the chief bone of the limb, as the tibia. The head of the fibula in these cases experiences a gradual displacement upwards. When it is the subordinate bone, as the fibula, or of equal rank, as one of the bones of the forearm, the other bone prevents the necessary approximation of the parts under muscular contraction, and the reproduced portions of the bone do not unite. Such, at least, has been my experience, but the cases are as yet too few to justify any confident general statement.

The operation is usually one of extreme facility. A very free incision should be made along the superficial aspect of the bone, and the periosteum separated by means of the handle of the scalpel, or other blunt instrument. This being done, a chain-saw is to be passed under the bone, and its divided ends seized with the lion-forceps and gently twisted. If they will come away from the epiphysial lines, the operation is over; otherwise the chain-saw must be again applied at the limits of the separated periosteum. If the articular end is also to be removed, its ligaments must of course be divided. It is far more satisfactory to find the separation of the dead bone already complete, than to have to make the division of the dead bone from the living with the saw, though cases are on record in which the latter proceeding has proved successful.

Space hardly allows of a proper discussion as to the propriety of such operations as these under different circumstances. In all the instances referred to the operation succeeded. In one, in which I removed a portion only of the shaft of the tibia, it failed, and amputation became necessary, the patient recovering. But the cases have been far too few at present to enable us to judge as to the relative safety of this course and amputation. All that I will say here on the subject is, that in early life (and most, if not all, these cases occur in childhood), when the whole thickness of the shaft of the bone perishes in consequence of acute periosteal abscess, and is separable from the neighbouring portions, subperiosteal excision appears to me to be indicated, and should be performed at the earliest possible period. Many of these cases terminate in the most gratifying manner; and a patient who would otherwise have been condemned to amputation, or have lost his life by pyæmia, rapidly recovers from the profound surgical fever which accompanies this complaint, and regains a very useful, though somewhat shortened limb. In less acute cases, where the amount of bone which has perished is smaller, and the surgical fever does not run so high, the expectant treatment is certainly justifiable and may often be advisable.

T. HOLMES.

THE PROCESS OF INFLAMMATION;

BEING THE COMPLETION OF THE ESSAY ON INFLAMMATION IN VOL. I.

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THE author who engages to give information to others on any subject with which he is supposed to be conversant, takes upon himself a serious responsibility. His first duty is to place his readers in complete possession of all the facts relating to the subject, which have been accepted by scientific men up to the time at which he writes, including in his statement such collateral information as is necessary for correctly judging of the grounds of their acceptance. But in addition to this primary obligation the reader has a right to expect that he will not be presented with a mere narrative of unconnected observations which he must himself arrange and apply to the solution of the questions at issue, but that the work of comparison and analysis shall be done for him, and those conclusions stated in clear language which have the best claim to be incorporated in the ever-changing body of scientific doctrine.

In the preparation of the following essay on the process of inflammation, I have made it my object to fulfil both these obligations without going beyond them, deeming that by doing so I should be most likely to make my performance of practical use. I have striven, above all, to be cautious in the selection and statement of facts, remembering how often misstatements, which find their way into the writings of those who assume to teach, are apt to retain their place long after the sources whence they were derived have been forgotten.

I have myself repeated most of the observations and experiments to which I have referred. I have done so, however, not so much in the hope of adding to them or correcting them, as for the purpose of making myself conversant with the methods and results.

It is hard to have to acknowledge that during the last ten years no research of any importance relating to the questions which will occupy us in the following pages has appeared in this country. The fact that we have to submit to receive instruction at the hands of German pathologists, instead of meeting them on equal terms, unwelcome as it is, is very easy to account for. In the present position of pathology, the methods which in times past have been employed with such signal success in this country are exhausted. Although it would be a great mistake to say that all that can be learnt by the rough investigations which can be made in the *post-mortem* theatre is already known, yet it cannot be doubted that for some years past every important advance in the science of disease has been accomplished, not by the collection of isolated observations, but by the same methods of systematic experimental research which are employed in physics and chemistry. The Pathological Institutes of Vienna and Berlin have no counterparts in Great Britain. The want of them is not only disadvantageous but fatal to progress—partly because they are necessary for the effectual carrying out of experimental inquiries, partly because, without them, that education in the methods of exact research by which alone a real pathologist can be produced is impossible.

Introduction.

By the 'process of inflammation,' I understand the succession of changes which occurs in a living tissue when it is injured, provided that the injury is not of such degree as at once to destroy its structure and vitality. With reference to their origin, all inflammations may be comprised in two classes—extrinsic and intrinsic. Of these two terms, the former is applicable to all those cases in which an injury, either sustained by the affected part or inflicted elsewhere, is the obvious cause of the morbid process; the latter to those inflammations which, from the concealment of their cause, are commonly called idiopathic. If, however, we desire to speak accurately, we must discard this word altogether; for there is no case in which it can be reasonably doubted that an injury must have preceded the earliest sign of local disorder, however little we may know either of the nature of the agent or of the mode of its action. We might advantageously substitute for idiopathic either of the words intrinsic or secondary; but inasmuch as there is no channel by which an agent from within, i.e. from some other part of the body, could penetrate into a tissue, excepting by the blood-vessels or lymphatics, we are entitled to use the only word which fully expresses this view of the mode of introduction of the material cause, and to designate all so-called idiopathic inflammations *infective.*

From what has been said it may be readily understood that the primary inflammations naturally affect those parts principally which are exposed to external influences, while those of the other class occur by preference in parts and organs to which there is no access excepting through the circulation. These distinctions, however, are not constant, for there are many instances in which secondary inflammations affect external parts, and many others in which internal organs are the seat of primary inflammations, as for example when nephritis arises from exposure to cold. Much more important distinctions, however, may be based on a comparison of the structural changes which the two processes determine in the tissues affected; or, in other words, on their pathological anatomy. In making this comparison, there is one important principle to be borne in mind. *In all inflammations, the form of the lesion is dependent on that of the area of influence of the injury.* Thus, in those cases of primary inflammation in which it may be supposed that an impression received by afferent nerves distributed to mucous or cutaneous surfaces, is reflected to internal organs (as in the case of nephritis from cold, already referred to), the area of influence of the injury is wide enough to comprise whole organs, and the resulting lesions are of corresponding extent. In the strictly local inflammations, the correspondence in form between cause and effect is, of course, closer and more obvious, the area of a traumatic inflammation being larger than that of the injury which produces it, but of exactly similar form. As regards infective inflammations, the correspondence is not so plain, but the consideration of their pathological anatomy is sufficient to satisfy us that it is equally complete. It is the anatomical character of all infective inflammations that the lesions to which they give rise are disseminated rather than diffused. Particles of matter, of the nature of which we can assert nothing, excepting that they are of extreme minuteness, are conveyed from a primarily inflamed part to other parts previously healthy, and become foci of infective induration or suppuration (miliary tubercles, pyæmic abscesses) each of which is the product—if one may be allowed the expression—of a single seed.

Although in a treatise on inflammation all the forms of the process ought to be discussed, I have thought myself justified in omitting the whole subject of secondary indurations and suppurations on the present occasion; not that I underrate its importance, but that the material for its satisfactory discussion is still wanting. The intimate pathology of the process of infective inflammation (e.g. tuberculous, scrofulous, or pyæmic) has been only very recently subjected to experimental investigation, so that, although pathologists are beginning to see the bearing of the facts already observed on clinical experience, the subject is not yet ripe for dogmatic exposition.

For a similar reason the consideration of those cases in which inflammatory processes originate at a distance from the locality directly affected by the injurious agent, must also be omitted; for the ideas we at present entertain with respect to them are not founded on experiment, but merely inferred by analogy, i.e. by comparison of what occurs with other known processes. The actual limits of pathological knowledge seem therefore to confine the scope of the present article to the discussion of those purely local inflammations which arise in a tissue in consequence of the direct application of injurious stimulation.

The purpose of this article is therefore to describe the effects of injurious irritation of tissues. Enumerated in the order of their apparent occurrence, they are (1) disorder of the circulation, (2) transudation of the constituents of the blood, and (3) altered mode of growth of the elements of the inflamed texture. As, however, it is more convenient to divide the consideration of these several derangements of function according to their seat than according to their nature, I propose to describe them under two headings—the first comprising all those changes which have their seat in the blood-vessels; the second, the alterations of the tissues.

SECTION I.—CHANGES WHICH HAVE THEIR SEAT IN THE BLOOD-VESSELS.

Part I.—Disorder of the Circulation.

When a grain of dust is accidentally introduced underneath the upper eyelid, much pain is felt, and the conjunctiva becomes vascular. This effect occurs so rapidly that it is difficult to suppose that the obvious dilatation of the vessels has been preceded by a preliminary state of contraction. On the other hand, we know from direct observation and measurement that if we irritate a minute artery, it contracts at the point of irritation. How are these two apparently opposed facts to be reconciled? Are we to suppose that, notwithstanding the shortness of the time that intervenes between the application of the stimulus and its effect, the apparent paralysis has been preceded by a transitory condition, or are we to believe that the condition of the arteries which leads to the increased activity of the capillary circulation is intermediate between that of complete relaxation and that of spasm?

Before entering on the consideration of this question, it will be well to give a short account of the vascular changes as they are seen in actual progress in the transparent parts of certain of the lower animals. For years the web of the frog's foot was the only field of observation. Now that, by the use of curare, we are enabled to obviate the difficulties arising from muscular movements, preference is often given to the tongue or the still more transparent mesentery.

When the mesentery is spread out (in the way to be hereafter more particularly described) for microscopical examination, the first change which is observed in the circulation, as a result of exposure to air, consists in dilatation of the arteries; the increase of width being accompanied by a corresponding increase of length, which manifests itself in more or less contortion. The dilatation begins immediately, and is ushered in by no antecedent stage of contraction. It is, however, progressive; the diameter of the artery gradually increases for ten or twelve hours, at the end of which period it is often twice as great as it was before; having thus attained its maximum, its size remains unaltered for many hours. This dilatation of the arteries is followed by a similar change in the veins, but inasmuch as there is a considerable interval between the two events, a time occurs at which the arteries, instead of being sensibly smaller than the veins which correspond to them, far exceed them in diameter.

Along with these changes the rate of movement of the blood is also altered. At the beginning of the process the circulation is quicker than natural. Yet although the two changes go on at the same time the acceleration cannot be regarded as a result of the increase of calibre; for the inevitable consequence of dilatation would be diminution, not increase, of the rate of movement, supposing the activity of the heart and the resistance opposed by the capillaries of distribution to remain the same. The absence of any causal relation between the two is still more clearly shown by what is observed at a later period; for whereas on the one hand, as has already been stated, the dilatation lasts for many hours, the acceleration is confined to the first stage of the process. The rate of movement soon returns to the normal, and this is shortly followed by a change in the opposite direction; so that by the time the arteries are fully dilated the circulation is much slower than it was originally.

Such are the main facts as they occur in the frog's mesentery. In so far as every inflammation begins with increased activity of the capillary circulation of the affected part, which is followed by diminished circulation, they may be considered as representative. Nothing, however, can be learnt from them as to the relation between these changes and the variations which occur along with them in the degree of contraction of the vessels themselves. For the study of this relation we must have recourse to other tissues in which the conditions of vascular contraction are better understood than they are in the mesentery. But before doing so it appears necessary to give a short account of what is at present known as to the influence of the nervous system on the blood-vessels.

During the last ten years important additions have been made to our knowledge of the innervation of the arteries. Many new facts have been discovered, and others previously known are better understood. To attempt fully to discuss them would exceed the scope of this article. I shall, therefore, confine myself strictly to those physiological considerations which have an immediate bearing on the disorder of the circulation which manifests itself in inflammation. Until Bernard proved by experiment that the nerves which preside over the arteries of the integument of the head are contained in the cervical portion of the sympathetic, the very existence of vaso-motor nerves was merely matter of inference. For a long time after that discovery, physiologists had no precise knowledge of the vascular nerves of the rest of the body. More recently, the mode of innervation of many other parts and organs has been demonstrated experimentally, particularly the right of the splanchnics to be regarded as the vascular nerves of the abdominal viscera, and the derivation of the vascular fibres of the upper and lower extremity from the sympathetic system, by means of communicating branches passing between that system and the anterior roots of the spinal nerves. By these researches the doctrine which has long been considered probable, viz. that all vascular nerves pass through the ganglionic nervous system, has been established. At the same time, it has been shown that although the vascular nerves are immediately derived from the sympathetic, their ultimate origin is to be found in the cerebro-spinal nervous system, as evidenced by the fact that when any part of the ganglionic cord is isolated by the division of its spinal attachments its vaso-motor functions are paralysed, the same vascular effects being produced as if the sympathetic were itself destroyed. We further learn that the vaso-motor nerves are not only subject, like other efferent nerves, to the direct action of stimuli, but that they may be excited in the reflex way by stimulation of certain afferent spinal nerves.. And hence we are compelled to admit that the whole vaso-motor system is under the control of an excito-motory centre. The precise position of this centre is as yet uncertain. We know, however, that it is in the intra-cranial part of the cord: in the first place, because some of the afferent nerves in relation with it are cranial, and secondly because section of the cord immediately below the *medulla oblongata* produces paralysis of the whole vascular system. Of the afferent nerves above referred to, the most important is that which is now known as the depressor,* a branch of the vagus, the excitation of which by a feeble interrupted current leads to a general reflex acceleration of the flow of blood through the capillaries.

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* For a full account of this subject, see E. Cyon and C. Ludwig, *Die Reflexe eines der sensiblen Nerven des Herzens auf die motorischen der Blutgefässe.* Ludwig's *Arbeiten*, 1867, p. 77.

As in other parts of the nervous system, the special physiology of the vascular nerves is known almost exclusively by experiments, in which the effects produced by the stimulation or division of particular nerves are observed. The most important results of this kind of investigation are, that section of a vascular nerve produces congestion of all the tissues to which it is distributed; that excitation by the interrupted current, or by mechanical means, produces constriction of the minute arteries presided over by the irritated nerve, and consequent anæmia; *that excitation of a sensory nerve produces increased activity of the capillary circulation in the part in which the nerve originates*; and, finally, that all arteries manifest alternating states of contraction and dilatation, their rhythmical movements being entirely independent of those of the heart and of breathing, and ceasing when the vessel is paralysed by division of its nerves.*

Of these results, the one which has the most direct relation to our present inquiry is the third. It is founded, as regards mammalia, on the well-known researches of Ludwig and Lovén, of which I content myself with giving a very cursory account, referring the reader to the original paper for more complete information.

All of Lovén's experiments were made on curarised rabbits † in which respiration was maintained artificially, so as to avoid the disturbing influence of muscular movements. The nerves selected for excitation were the large nerves distributed to the external ear of the rabbit, and the *dorsalis pedis*. When the central end of a divided auricular nerve is excited by feeble induced currents, congestion of the corresponding ear follows in a period which varies from three to six seconds. This congestion is more intense than that produced by section of the sympathetic, and is accompanied with obvious dilatation of the arteries, varying in duration according to the degree of the excitation, and the time for which it is continued.* In the experiments in which the *n. dorsalis pedis* was excited, the *arteria saphena* was made the subject of observation. As this vessel in the rabbit is easily exposed in its long course down the inner surface of the thigh, derives its vaso-motor branches exclusively from the *n. saphenus*, and is distributed in great measure to the same region as the *dorsalis pedis*, it is particularly suited for the purpose. The results are as striking as in the other case. The vessel begins to enlarge and pulsate visibly a few seconds after the commencement of the stimulation. The dilatation soon attains its maximum and begins to subside, lasting only a very short time after the removal of the electrodes from the nerve.†

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* Of these results, the first and second may be easily demonstrated in the rabbit by section of the cervical sympathetic followed by excitation of the peripheral end of the divided nerve; in the frog by section and excitation of the spinal cord. The effects of the excitation of the depressor nerve can only be shown in the rabbit. The modes of experiment required are described in my physiological lectures recently published in the *Medical Times and Gazette.*

† I have found, however, that all the facts observed can be demonstrated in animals under the influence of chloral (six grains or more in solution injected into a vein). In this way the experiment is rendered much easier and can be done without inflicting any pain on the animal.

In the frog the vascular nerves which supply the web find their way by various channels to the arteries to which they are distributed, so that there is no single trunk by the division of which these vessels are completely paralysed. It is probable, indeed, that the distribution of the vascular filaments differs in different individuals, for while in some frogs division of the sciatic nerve in the thigh widens the arteries very distinctly, in others it produces no appreciable effect, either on the state of the vessels or on the activity of the circulation. There is a similar uncertainty in the results produced by exciting the peripheral end of the divided sciatic, which obviously, if that nerve always contained vaso-motor filaments, ought always to induce arterial contractions. In some frogs it is so, i.e. when the peripheral end is excited, the arteries contract markedly, and the circulation is suddenly arrested, but in others the effect is so inconsiderable as scarcely to admit of demonstration. If, however, the central ends of the divided sciatic be excited, the opposite effect—namely, increased activity of the circulation—shows itself with much greater constancy, proving that however variable may be the proportion in which vaso-motor filaments are contained in the sciatic nerve, the arteries of the web are always supplied more or less completely through other channels.

The accelerating influence of excitation of the central end of the divided sciatic on the circulation has been lately so carefully studied by Professor Stricker and Dr. Riegel that there can be no doubt of its nature. The method they employ consists in comparing the movement of the blood-corpuscles in a selected arteriole with that of a current of water containing particles of solid matter in suspension, which is so arranged as to pass through a horizontal tube fixed on the eye-piece of the microscope at such a distance from the eye-glass as to be distinctly seen by the observer. The apparatus by which this current is produced is so constructed that its rate can be varied at will, and its actual velocity at any given moment can be determined. The comparison is made by first fixing the attention on the arterial current, and then accelerating or retarding the test-current until the two velocities are equal. By this means it is obvious that any diminution or increase in the rate of movement can be appreciated with the greatest exactitude. With a view to the observation, the frog must be slightly curarised ($\frac{1}{2000}$th of a grain of curare in solution injected under the skin). The sciatic nerve having been divided on one side, the web is placed under the microscope, so that a small artery passes through the field in a direction which coincides with that of the test-current. As soon as the two movements have been brought to agreement, the central end of the sciatic is excited by a moderate current, immediately after which the acceleration begins, and goes on increasing so long as the irritation is continued, even when the observation lasts for half an hour, or longer.* In all Dr. Riegel's experiments the acceleration of the blood-stream was associated with some narrowing of the vessels. This observation was so carefully and so frequently made by him, that I should not doubt of its reality, even if I had not satisfied myself of its truth by repeating it. Its importance is obvious, for it affords the strongest ground for believing that in certain states of the arteries accelerated flow of blood may be associated with persistent reflex arterial contraction.

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* In my experiments, the dilatation had often disappeared ten or twelve seconds after the commencement of excitation.

† Chr. Lovén, *Ueber die Erweiterung von Arterien in Folge einer Nervenerregung.* Ludwig's *Arbeiten*, 1867, p. 1.

There are several instances known to physiologists in which contractions of arteries are produced which are not attended with increased activity of capillary circulation, but, on the contrary, with anæmia—as, for example, by excitation of the peripheral end of the sympathetic in the neck after division, in the rabbit, or by excitation of the spinal cord in the frog. If this were only the case when vaso-motor nerves are irritated directly, we could more readily understand it; but it also happens under conditions which so closely resemble those which we have been considering, that at first sight the results are difficult to reconcile. Saviotti has lately found that by exciting the cutaneous surface in various ways, e.g. by tapping on the integument of the belly, by pricking the skin of the same part or of the back, or by pinching the toes, very marked contraction of the arteries of the web of the frog's foot can be produced, which is attended not with increased but diminished progressive movement of the blood, amounting for the moment to complete arrest of the circulation. As I have said, this looks at first contradictory, but before we judge of its bearing on our present question we must call to mind that the conditions of Saviotti's and Riegel's experiments are not so comparable as they seem. It is well known as regards some at least of the modes of irritation employed by Saviotti, that they act not merely on the vaso-motor nerves but on the vagus heart-nerves. I need not remind the reader that tapping on the belly of the frog arrests the movements of the heart in diastole just in the same way as direct excitation of the vagus itself does. Consequently in Saviotti's experiment we are not merely obliged to admit the possibility that the arrest of movement is partly cardiac, but are tolerably certain that it must be so. This consideration is of great importance; for although there is no doubt that anæmic contraction of arteries is an ordinary consequence of direct stimulation of vaso-motor nerves, there is no case (except that of Saviotti's experiments) in which anæmia is produced by reflex irritation.[*]

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* Riegel, *Ueber die reflectorische Innervation der Blutgefässe. Med. Jahrbücher*, 1871, p. 101.

Our knowledge of the innervation of the blood-vessels is, notwithstanding the progress which has been made during the last few years, too imperfect to enable us to harmonise all the facts. But the impossibility of constructing a complete theory on the subject does not prevent us from drawing some inferences which will be of use in enabling us to understand what happens in inflammation, at all events better than we should do without them. From what has been stated, it is tolerably clear that whatever difference there may be in other respects, there is one effect of exciting the sensory nerves distributed to any part which is pretty constant, viz. increased activity of the circulation; so that whether the actual quantity of blood existing in the part at any given moment be greater or less, the quantity of blood which passes through it in a given time is certainly greater.

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[*] Saviotti, *Untersuchungen über die Veränderungen der Blutgefässe bei der Entzündung.* Virchow's *Archiv,* vol. i. p. 592.

In the commencement of the process of inflammation in the web of the frog's foot the successive changes are similar to those I have already described in the mesentery, but differ considerably according to the irritant employed. Most irritants, such as weak solution of caustic soda, dilute sulphuric acid, &c. produce dilatation first of the arteries and subsequently of the capillaries, with marked acceleration of the circulation—these conditions being followed by arterial contraction and capillary anæmia. But liquor ammoniæ and carbonate of ammonia in substance, appear always to occasion a certain degree of primary arterial contraction, which begins in one or two minutes after excitation, and is attended with retarded flow of blood through the capillaries, with distension of the branches given off by the artery nearer the heart, and increased activity of circulation in the neighbourhood of the irritated part. This state of things lasts for an hour or two, and is succeeded by dilatation and acceleration. In other words, ammonia and carbonate of ammonia produce results which are directly opposed to those of other stimuli. Croton oil appears to occupy an intermediate position between the first-named stimulants and ammonia, for while it always gives rise to acceleration of the flow of blood as a primary result, this change is sometimes associated with widening, sometimes with narrowing of the arteries. So that here, as in the case of reflex electrical stimulation of sensory nerves, the only fact which is constant is acceleration.

In order to judge whether the two kinds of acceleration we have been considering are of the same or opposite nature, the best way is to observe their action simultaneously in the same part. If, for example, in the web of the frog's foot the acceleration due to excitation of the central end of the sciatic is of the same nature as that of inflammation, we should expect it to be increased by local irritation; and, conversely, the effect of irritation, if already existing, to be heightened by exciting the nerve. The very careful experiments of Dr. Riegel show that it is so. Having found that after section of the sciatic the effects of irritation were slightly retarded but otherwise unmodified, he repeated the observation in another animal, excited the central end, and then applied croton oil to both webs. On the injured side the accelerating effect of the croton oil lasted much longer than on the other, so that at the time stasis had already set in on the sound side, the circulation was going on more briskly than natural on the injured side.

As regards the precise nature of the modification of vascular contractility which is associated with the primary quickening of the capillary circulation, we cannot venture to speak in any terms more precise than have been already employed. The effect of local irritation is certainly not to paralyse the arteries leading to the irritated part, but rather to modify their *tonus* in such a way as to facilitate the flow of blood through them. For the present we must be content to leave the question open, for no good would be gained by endeavouring to conceal the insufficiency of our knowledge under a comprehensive theory.*

In all forms of inflammation of sufficient intensity, the circulation after a variable period of excitation becomes retarded. This effect is so closely associated with the other phenomena of the second stage of the process of inflammation, that it cannot be advantageously studied until they have been considered (see p. 745).

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* Many physiologists are of opinion that the arteries do not act merely as dead elastic tubes, but are endowed with powers of contraction analogous to those of the intestine. If this be admitted, it can be easily shown that the quantity of blood conveyed by an artery in a given time, and consequently the activity of the capillary circulation, might be increased by alterations in the contractility of the tube of a nature the very opposite of that of relaxation. Such a theory supposes that an artery, after it is distended by the injection of blood from the heart, does not content itself with returning to its state of elastic equilibrium, but that at a variable interval after receiving the systolic shock of the heart it contracts actively on its contents, just as a bit of intestine would do, and thus assists in propelling them. Admitting it to take place, the effect of such contraction would depend not merely on its intensity, but on the relative duration of the period of arterial distension as compared with that of the succeeding collapse. Thus if the contraction were so immediate as to happen while the artery was still acted upon by the heart, and consequently to coincide with what would otherwise be the period of greatest distension if the artery were a dead elastic tube (that is to say, about a tenth of a second or so after the shock), it is evident that it would tend to impede the circulation by increasing the resistance of the artery; but if, on the other hand, it were postponed until after the operation of the *vis a tergo* had ceased, it would not only keep up the flow of blood during what would otherwise be the period of greatest retardation, but would prepare the way for a more effectual filling of the artery at the next systole by previously emptying it of its contents.

PART II.—EXUDATION OF LIQUOR SANGUINIS AND LEUCOCYTES.

IT IS now many years since it was taught by Dr. C. J. B. Williams, as the result of his own observations on the phenomena of inflammation in the web of the frog's foot, that in the second stage of the process, when the capillary circulation is becoming retarded, there is an apparent increase in the number of white blood-corpuscles in the vessels, and that they manifest a remarkable 'disposition to adhere to their walls.'* Dr. Williams attributed these appearances to the production in the vessels of inflamed parts, of young colourless blood corpuscles differing from those ordinarily met with in their consisting, not of cells (in the sense in which the word was then, and for many years afterwards understood, as implying the existence of nucleus, membrane and contents), but of masses of gelatinous consistence (p. 328). He considered that their tendency to adhere to the internal surfaces of inflamed vessels, and to creep along them, was due to their not having membranes (p. 331). He further observed that 'in the frog's web, after inflammation has continued for some hours, there appear outside of the vessels, especially where the strongest current encounters the most complete obstruction, white globules or corpuscles with specks in them, exactly like the pale granular globules within the vessels' (p. 335). He did not, however, suppose that the objects so exactly resembling each other which he saw outside and inside of the membrane respectively, were in reality identical; for although Dr. Addison had already maintained that pus globules and the white globules of the blood were indistinguishable from each other, and had represented that in inflammation the white globules first passed into the substance of the wall of the blood vessel, and were then thrown out from it, it appeared to Dr. Williams so difficult to understand their passage through the walls of vessels in which no pores are visible under the highest magnifying powers, that such an explanation could not be accepted.

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* *Principles of Medicine,* 3rd ed. p. 330.

In 1846 the statements of Dr. Addison were confirmed by the late Dr. Augustus Waller. His paper on the subject displays such clearness in the description of the phenomena he observed as to leave no doubt in the mind of the reader that he actually saw what he represents. 'In some instances,' says Dr. Waller, 'the manner in which the corpuscle escaped from the interior of the tube could be distinctly followed; that part of the tube in contact with the external side of the corpuscle gradually disappeared, and at nearly the same time might be seen the formation of a distinct line of demarcation between the inner segment of the corpuscle and the fluid parts of the blood in contact with it. Any slight agitation then was capable of disengaging the corpuscle from the vessel to which it was now external,' &c. * This passage is taken from a description of one of Dr. Waller's experiments. I quote another which contains his explanation of the phenomena. 'In endeavouring to account for the fact of the passage of the corpuscles through the vessels, we find considerable difficulties. It cannot be referred to the influence of vitality, as it is observed likewise to take place after death. It may be surmised, either that the corpuscle, after remaining a certain time in contact with the vessel, gives off by exudation from within itself some substance possessing a solvent power over the vessel, or that the solution of the vessel takes place in virtue of some of those molecular actions which arise from the contact of two bodies; actions which are known as exerting such extensive influence in digestion, and are referred to what is termed the catalytic power' (p. 402). That the speculations and observations of Dr. Addison, even when so definitely confirmed by Dr. Waller's experiments, fell into oblivion, is to be attributed partly to the theories about cells which then prevailed, and partly to the extreme difficulty of the investigation. For it is to be remembered, to Dr. Waller's great credit, that neither curare nor chloroform, which have since so wonderfully facilitated research, were at his disposal, and that consequently anything like minute observation of the phenomena was rendered almost

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* Microscopical Observations on the Perforation of the Capillaries by the Corpuscles of the Blood, and on the Origin of Mucus and Pus Globules. By Augustus Waller, M.D. *Philosophical Magazine*, vol. xxix. p. 397, 1846.

impossible; for it was only by patiently waiting for short moments of tranquillity that the observer could see anything.

Before proceeding to the consideration of the discoveries which have rendered Professor Cohnheim's name so well known, it is desirable to give some account of the successive steps of investigation by which the true relation between the colourless corpuscles of the blood and other similar forms occurring in the tissues, either in health or disease, has been recognised. The common physiological property by which all these bodies are associated is that of spontaneous movement, manifesting itself either in progression or merely in continuous change of form. The bodies possessing this property are called in German by the terms *bewegliche Körperchen*, *Wanderzelle*, *Lymphkörperchen*, for which I propose to employ the English equivalent leucocyte,* understanding it to mean a mass of contractile living protoplasm. The importance of this definition in relation to our present inquiry is very great, for so long as a blood-leucocyte was supposed to be a cell, in the sense in which the term cell was used twenty years ago, it was quite impossible to understand how it could find its way through a structureless membrane; but from the moment that it was understood to be a mass of contractile material similar in all respects (which can be judged of by observation) to that which forms the body of an amœba, and endowed with a similar faculty of movement, the process became much more intelligible. Although the comparison between the movements of amœbæ and those of leucocytes is so familiar, it cannot be considered either an undue digression from the subject, or a waste of the reader's time, to recall to his recollection some of the facts relating to the mode of life of these organisms which fit them to serve as illustrations of the contractile corpuscles of the higher animals.

With this view the best examples which can be selected are the gigantic amœbæ which are known to biologists as the

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* Dr. Williams, in a recent note (*Med. Times*, Jan. 21, 1871), objects to the term leucocyte, that the body to which it is applied is not a cell, and suggests the adoption of a new word, viz. Sarcophyte, which corresponds more exactly with its anatomical characters and its physiological properties. I have nothing to advance in answer to Dr. Williams' arguments. Sarcophyte is clearly the more expressive and accurate word, but it is unknown; whereas leucocyte is well understood on both sides of the Channel. Moreover, the word cell, and its Greek equivalent, have so entirely lost their original meaning, that surely no misunderstanding can arise from their use.

Plasmodia of the Myxomycetes, and the more familiar forms which are closely related to the Monads. The myxomycetes, although possessing some of the characteristics of animals, have been always, on account of their development and mode of growth, associated with the fungi.* Like other fungi, they originate from spores. If the spores of *Physarum* (a genus of myxomycetes) are sown in water on an object-glass, and examined under the microscope twenty-four to thirty-six hours afterwards, the water is seen to be peopled with contractile corpuscles, each of which is at first provided with a single cilium, and contains, in addition to a contractile vesicle, a delicate vesicular nucleus, usually placed in the neighbourhood of the cilium. In its original state the corpuscle moves about so actively that the contractions of its substance cannot be studied; but after a while the cilium falls off or is retracted, and it then assumes in every respect the aspect and character of an amœba. Let us for a moment study its motions.

The mass is constantly changing its form. But as these changes go on in all parts of the hyaline substance of which it consists, simultaneously, the only way in which they can be understood is by confining the attention to one point at a time. If this is done it is seen that each act of movement begins by the budding out of a ray or process of contractile substance in a centrifugal direction. What next happens varies in different cases. Sometimes the projection subsides just in the same way as it was formed; at others the finely granular fluid, or rather labile matter, which occupies the more central parts of the corpuscle, streams into the offshoot, gradually widening it out, until it grows into a mass greater than the remainder, which it finally draws into itself. It is evident that the process last described must always be attended with locomotion, for each time it is repeated the whole mass rallies round a new centre, the position of which corresponds to the extremity of the offshoot. If the amœba always sprouted in the same direction, the progress would be continuous and rectilinear; as, however, there is no appreciable order in its efforts, its locomotion is correspondingly irregular.

The form of the adult plasmodium of Didymium, another genus, is shown in Fig. 396. It consists of a reticular film of grey fibres which spreads over the rotten leaves on which the plant vegetates, and would be regarded by the casual observer (if he recognised its claim to be considered a living structure at all) as undoubtedly a fungus. Under the microscope it is found to be neither more or less than an enormous mass of contractile protoplasm; for every part of it is constantly undergoing changes of form similar to those already described in the minute amœba, with which (as Cienkowsky's researches have clearly shown) it is organically continuous. As illustrative of the manner in which hyaline contractile material may shape itself into specific form without the intervention of cells, it is well worthy of our attention. Its mode of growth can be best understood by observing what takes place at the edge of the network. Here it is seen that the filaments grow terminally, and that although there is amœboid movement in every part, this movement is much more active at the growing points than elsewhere. It is further seen that the process by which the growing end lengthens, is exactly similar to that by which the original amœba throws out rays. In each filament the outer part appears to be hyaline and contractile, the central part labile and granular; and when the process of elongation is carefully observed, it is seen to consist first of a budding out of the external substance, and secondly of an afflux (preceded by more or less marked alternations of ebb and flow) of the axial semi-fluid matter towards the growing point. The reticular arrangement of the filaments results from the fact that every marginal growing end meets with another, with which it unites so as to form a loop. The union, however, is not

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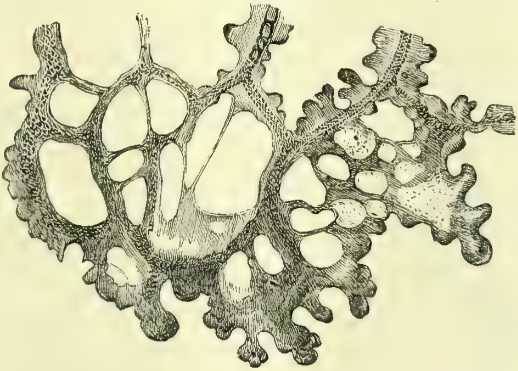
* L. Cienkowski, *Das Plasmodium. Zur Entwickelungsgesch. der Myxomyceten. Jahrbücher für wissenschaftliche Botanik*, vol. iii. pp. 325, 400.

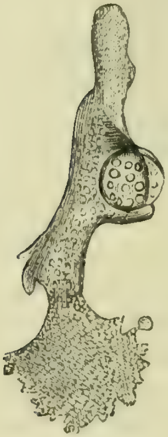
FIG. 396.



instantaneous, but gradual. For a time the two ends are merely in contact, the labile axial matter being separated by a double septum of hyaline substance. Gradually the septum melts away, and a channel of communication is established in which the ebb and flow of currents can be distinguished.

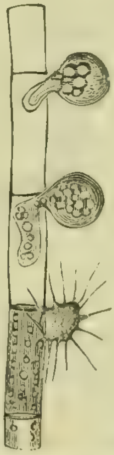
The purpose I have had in view in giving this short sketch of the mode of life of the myxomycetes is to show that in contractile protoplasm the two functions of motion and growth are, so to speak, confused together in such a manner that the more closely we scrutinize the mode in which they are exercised the more difficult does it appear to distinguish them. No reference has as yet been made to another power which all amœbæ possess—that of absorbing the nutritive substances with which they come into contact. This property is manifested in perfection in the colossal amœbæ we have been studying, which not only appropriate material derived from the soil with which they are in contact by their external surfaces, but surround their food with their own substance for the purpose of digestion (Fig. 397). I prefer, however, to seek for an illustration in the

Fig. 397.



A plasmodium beginning to surround a vegetable cell containing chlorophyll.

Fig. 398.



At the lower part of the figure a Vampyrella is beginning to adhere to a cell containing protoplasm and chlorophyll granules, which it is about to plunder. The other two cells have been perforated and their contents drawn into the bodies of the Vampyrellæ, which have retracted their processes history of those more minute forms which, from their close relation to the Monads, have always been regarded as animal.

I select as an example an amœba called by Cienkowski *Vampyrella Spyrogyræ*,* the specific name of which is derived from the confervoid alga on which it lives parasitically. Its appearance is shown in Fig. 398. It is granular towards the centre, hyaline at the surface, and the superficial part shoots out into pointed rays, or less frequently buds into obtuse promontories, in which an oscillation of granular matter is seen similar to that already described. It moves about apparently without purpose until it meets with a filament of Spyrogyra. It then adheres to the external cellulose membrane of the alga, and soon penetrates it. It thus comes into contact with the protoplasmic lining (primordial utricle) of one of the cells of which the filament is composed, which it at once proceeds to exhaust of its chlorophyll, drawing it into itself through the narrow opening which it has made in the cell wall. After having plundered several cells in this way, the amœba, much increased in size, entirely ceases its movements, and becomes enclosed in a distinct envelope, in the interior of which new amœbæ are formed by an endogenous process which it is unnecessary to describe.

Although the morphological relations of amœbæ are so various and in many instances so undetermined that no single example can be taken as typical, yet those above related may serve to render more intelligible the following general statement. It appears to be well ascertained that it is the destiny of every amœba, after it has enjoyed its active life for a certain time, to assume the immobile condition, in which it becomes invested in a membrane; and that as this transformation is always preparatory to its entering on the reproductive function, no amœba can itself be a parent. It is also certain that all amœbæ, so long as they continue in the active state, are endowed with a remarkable power of dissolving and absorbing the nutritive substances on which they live. In connection with this faculty, the exercise of which may be regarded as the final cause of all their movements, they are able, at one time, to surround the material to be digested with the substance of their own bodies, at another to penetrate membranes in which there are no visible pores, when such membranes are interposed between them and their food.

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* Cienkowski, *Beiträge zur Kenntniss der Monaden.* Schultze's *Archiv,* vol. i. p. 203.

Amœboid movements of leucocytes.—The first precise observations on the amœboid movements of leucocytes were those of Professor v. Recklinghausen, contained in a paper on suppuration which appeared in Virchow's *Archiv* in 1863.

The publication of this research may be well considered as the commencement of a new era in histology,* not so much on account of the importance of the facts announced in it, as because the author enforced a principle which, at all events in its application to pathology, was at that time new, though it is now recognised by every one—namely that the elements of tissues, especially those in which life is most active, are so altered in the very act of dying, that the appearances they exhibit when dead and still more when disfigured by immersion in such liquids as acetic acid or water, are mere caricatures of their true aspects; for although the dead remains may be full of instruction, yet if we wish to know organic forms as they are, they must be studied either in the living state or at all events under physical and chemical conditions resembling those of life as closely as possible.

Guided by this principle of research, Recklinghausen was able to show, for the first time, that the changes of form of leucocytes are of the same nature as those of amœbæ, that they are capable of surrounding particles of any kind, if sufficiently small, with their own substance, and that they possess the power of moving from place to place. The first of these facts is established in his paper by observations on the pus corpuscles which are to be found in the liquid obtained by puncturing the anterior chamber of the eye of the frog a few days after keratitis has been produced by the application of nitrate of silver to the cornea. The description given of the movements as they are seen in the turbid humor aqueus, provided that it has undergone no change either by evaporation or pressure, is as follows: 'The corpuscles differ very strikingly in their form from those from which the ordinary descriptions are taken. . . . No globular forms present themselves—only jagged ones, and the prongs vary both in length and number. But what strikes one even after very brief examination is, that each corpuscle is constantly changing its shape. While one prong withdraws itself into the body of the corpuscle, another juts out. Each prong is at first a delicate, homogeneous, somewhat shiny thread, but soon it thickens at the base, lengthening at the same time; then gradually the substance of the corpuscle tends more and more towards it, becoming smaller as the process gets larger, the whole thus assuming an oblong or protracted form. During this transformation . . . the tip of the process is rounded off and subsides into the contour of the corpuscle; or new delicate thread-like processes shoot out, which again undergo the same changes.' *

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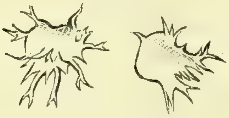
* It is somewhat difficult to state to whom the merit of having discovered the amœboid movements of leucocytes is to be assigned. There is no doubt that they had been noticed by several anatomists before they were made the subject of special investigation. Among the more important early observations on the subject may be noticed those of Virchow on the corpuscles of hydrocele fluid (Virchow's *Archiv*, vol. xxviii. p. 238), of Lieberkühn on the fluid of ascites (Müller's *Archiv*, 1854, p. 15), and those of Messrs. Busk and Huxley on mucous corpuscles, in a note to their translation of Kölliker's *Microscopical Anatomy* (p. 46).

FIG. 399.



Amœboid leucocytes (after v. Recklinghausen).

The ingestive power of leucocytes is proved by experiments in which Recklinghausen introduced milk into the lymph cavities of frogs, the result being that the blood leucocytes became 'choked with milk globules.' Subsequently he injected finely divided vermilion with like effect, and in this way introduced a method of research which has since been much employed by pathologists—that of distinguishing the blood leucocytes from those indigenous to the tissues, by feeding the former with some insoluble colouring matter injected into the circulation.

The proof of the faculty of locomotion is derived from another experiment which is in fact only a continuation of that already mentioned. Vermilion having been previously injected into a lymph cavity of a living frog, a rabbit's or dog's cornea, taken from an animal several hours dead, is introduced into it, and

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* V. Recklinghausen, *Ueber Eiter- und Bindegewebskörperchen.* Virchow's *Archiv,* vol. xxviii. p. 157.

left there two or three days. The lymph sac of course becomes inflamed, and it is found on removing the fragment that whereas the centre remains transparent, the more superficial parts are turbid. And if the preparation is immediately submitted to microscopical observation under conditions consistent with the maintenance of life (i.e. immersed in a nutritive liquid), it is found that the turbidity is due to the presence of amœboid leucocytes in the cavities of the dead tissue. That these elements are derived from the purulent liquid in which the fragment is bathed, and must therefore have found their way into the positions which they occupy by migration, is evidenced not only by their vital movements and their containing vermilion granules, but by their exhibiting the size and other characters of leucocytes of the frog.*

Even at this early stage in the investigation, v. Recklinghausen recognised the bearing of his discoveries on several difficult questions relating to inflammation; as e.g. in explanation of the tendency of pus to find its way to the surface or into the great cavities of the body, and of the mode in which disseminated foci of suppuration originate; and he also brought them into relation with the notions entertained by earlier pathologists as to the part taken by blood-leucocytes in the formation of new tissues. He even went so far as to attribute the collection or accumulation of leucocytes on the surfaces of inflamed serous membranes to migration; but assumed that they must have originated by 'proliferation' in the neighbouring connective tissue, and must have followed pre-existing channels in their wanderings. Thus, although it may be said that he did not himself, so to speak, complete his own discoveries, and left it to others to develop them to their necessary consequences, there can be little doubt that he gave a new impulse to pathological research, the effect of which has shown itself in the more brilliant achievements of Cohnheim and Stricker.

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* This experiment has been since repeated in a variety of ways. The most striking is that of Prof. Lortet of Lyons, who found that when any porous substance is introduced into a suppurating cavity, the leucocytes penetrate into it in the same way as they do into the dead cornea. And if the experiment is so arranged that the porous material encloses a liquid (as e.g. when the swimming bladder of a small fish filled with water or saline solution is inserted into an abscess), the liquid soon becomes peopled with leucocytes. The same thing happens when a similar pouch, shaped out of vegetable parchment, is used. Lortet's experiment, as well as those of v. Recklinghausen, have been repeated in the Physiological Laboratory of University College during the past winter. More full information respecting them will be found in the author's lecture on *Leucocytes*, already referred to.

The experiment by which Cohnheim first demonstrated the escape of the blood leucocytes in the early stage of inflammation is as follows.* A male frog, which has been paralysed by injecting under the skin about $\frac{1}{2000}$ grain of curare an hour before, is secured on a plate of glass of convenient size for the purpose. A vertical incision is then made in the abdominal wall about half an inch in length, extending from the lower edge of the liver downwards. As much of the small intestine is then drawn gently out of the visceral cavity as is necessary in order that the mesentery may be evenly spread on a disk of glass which is fixed in a convenient position for the purpose. If the operation is performed with care and skill, it may be effected without bleeding and without in the slightest degree deranging the circulation.†

In order to obtain a general view, it is best to commence the examination with a low power. It is then seen that the arteries are smaller than the veins, the latter exceeding the former in diameter by about a sixth, that the arterial stream is quicker than the venous, that it is accelerated appreciably at each beat of the heart, and that in every artery a space can be distinguished within the outline of the vessel, which is entirely free from corpuscles. The arterial stream is so quick that the forms of the corpuscles cannot be discerned, but in the veins both coloured corpuscles and leucocytes can be distinguished, and from the first it is noticeable that while the former are confined to the axial current, the latter show a tendency to loiter along the inner surface of the vessel, like round pebbles in a shallow but rapid stream. So far all is normal, and may remain so for many hours, but in most cases changes occur in consequence of the exposure of the peritonæum, which are the beginning of inflammation.

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* Cohnheim, *Ueber Entzündung und Eiterung.* Virchow's *Archiv*, vol. xl. p. 27.

† The most convenient apparatus for the purpose consists of (1) A glass plate four inches long and two and a-half inches broad. (2) A common three-inch object-glass, to one side of which a glass disk four-fifths of an inch in width has been fixed with Canada balsam, in such a position that it projects by a third of its diameter beyond the edge of the object-glass near the middle. Around the adherent part of the disk there is an uncovered space of about one-tenth of an inch in width for the reception of the coil of intestine; and outside of this, an imperfect ring of cork to which the intestine may be pinned with fine needle-ends. The object-glass, with its disk, is fixed to a larger glass plate, at such a height above it that the free edge of the disk presses against the side of the frog's body, immediately below the incision, and is thus conveniently placed for the reception of the mesentery.

The first abnormal phenomena observed have been already fully discussed—those of increased activity of the capillary circulation. On dilatation of the arteries of the mesentery follows a corresponding though less marked enlargement of the veins. During this stage the observer who desires to note the subsequent changes, must select for that purpose a vein of about $\frac{1}{500}''$ in diameter, the exact width of which it is desirable to measure either with the micrometer, or by marking its outline as projected on a sheet of paper with the drawing prism. For a couple of hours or more (the time varying in different animals) nothing whatever is to be observed except that although the vein gradually enlarges while the velocity of the venous current shows no abatement, the capillary circulation becomes more and more active; but sooner or later a change occurs which must be watched for with the utmost attention. This consists in a marked and almost sudden diminution of the rate of the current in the vein, in which that in the capillaries necessarily participates: it is the forerunner, and in some sense the cause, of the emigration which we desire to witness.

Simultaneously with the retardation, the leucocytes, instead of loitering here and there at the edge of the axial current, begin to crowd in numbers against the vascular wall, as was long ago described by Dr. Williams.* In this way the vein becomes lined with a continuous pavement of these bodies, which remain almost motionless, notwithstanding that the axial current sweeps by them as continuously as before, though with abated velocity. Now is the moment at which the eye must be fixed on the outer contour of the vessel, from which (to quote Professor Cohnheim's words) here and there minute colourless button-shaped elevations spring, just as if they were produced by budding out of the wall of the vessel itself. The buds increase gradually and slowly in size, until each assumes the form of a hemispherical projection, of width corresponding to that of a leucocyte. Eventually the hemisphere is converted into a pear-shaped body, the stalk end of which is still attached to the surface of the vein, while the round part projects freely.

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* See Dr. Williams' Gulstonian Lectures, published in 1841, in the *Medical Gazette.*

Gradually the little mass of protoplasm removes itself further and further away, and as it does so, begins to shoot out delicate prongs of transparent protoplasm from its surface, in nowise differing in their aspect from the slender thread by which it is still moored to the vessel. Finally, the thread is severed, and the process is complete. The observer has before him an emigrant leucocyte, which in all appreciable respects resembles those which have been already described in the aqueous humour of the inflamed eye.*

The experiment I have described, even if the phenomena are not observed with that care which is necessary in order to obtain a satisfactory result, is yet very convincing. For even if one fails from want of patience to watch an individual corpuscle through the successive stages of its escape, there are other obvious facts which are too significant to be misunderstood. The accumulation of innumerable leucocytes round veins which were before entirely free, the absence in these bodies of the faintest indications of any process by which they could be supposed to be developed where they are, the obvious identity of the leucocytes outside with those inside, the pedicles by which at all stages of the process many of the corpuscles hang on to the outer surface of the vessels—all these are facts which make it impossible to admit either that the corpuscles have been formed in the situations which they occupy, or that they have migrated from any other quarter excepting from the blood-stream.

In his observation on the same process in the tongue of the frog,† Professor Cohnheim follows the method originally employed by Dr. Waller, excepting of course that the animal is curarized, and that in order to facilitate the observation the mucous membrane is partially removed. The process of migration goes on in the tongue just as in the mesentery; but (to quote once more from Cohnheim) 'with such promptitude and certainty, and if the expression may be allowed, with such elegance,' that he feels tempted to prefer the former to the latter as an object of experiment.

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* From the description given above, it might be inferred that the experiment is one of great simplicity, whereas in practice it is attended with very considerable difficulty; so much so, indeed, that most persons who have tried it have found failure more frequent than success. The principal sources of difficulty are, 1st, that the time occupied in the first stage of the process, during which the circulation is going on with unabated velocity, is extremely variable; 2ndly, that if, from weariness or inadvertence, the attention of the observer is diverted from the selected vein at the commencement of the process of migration, he is very unlikely to succeed in seeing what he desires to see afterwards; for, inasmuch as leucocytes are escaping simultaneously in various parts of the mesentery, they soon accumulate in such numbers that their mode of exit can no longer be distinguished. Yet, notwithstanding these difficulties, no one who has time and patience enough need fail; great care in manipulation is required, but no extraordinary dexterity.

† Cohnheim, *Ueber das Verhalten der fixen Bindegewebskörperchen bei der Entzündung.* Virchow's *Archiv,* vol. xlv. p. 333. From comparative observations made recently, I am led to recommend the tongue as decidedly a better subject for study than the mesentery.

From these facts Cohnheim concludes 'that all such corpuscles as are formed in the first stage of an acute inflammation certainly originate from the vessels,' but admits that they do not enable us to arrive at any determination of the question whether or not pus-cells originate in other ways in the later stages (p. 350).

The bare fact of emigration when first announced took every one by surprise. Notwithstanding, it was very soon accepted by pathologists, partly because their minds were prepared by the previous discoveries of v. Recklinghausen, partly because Cohnheim's statements bore upon them the stamp of straightforwardness and accuracy. Unfortunately many of Cohnheim's adherents have not been content with receiving the fact, but, as so often happens in similar cases, have attributed to it a wider significance than that assigned to it by the discoverer himself. The passage I have quoted above affords evidence that the doctrine commonly spoken of as Cohnheim's—that pus-corpuscles originate entirely and exclusively from the blood, and that the tissues have nothing to do with their production—is in reality not his.* He evidently sees as plainly as others that, although in the commencement of every acute inflammation the first generations of pus-corpuscles may be emigrants, there is nothing in the facts which contradicts the previously accepted belief, supported as it is by so overwhelming a mass of evidence, that the later generations are the offspring of the inflamed tissues.

I have now said all that appears necessary on the subject of the migration of leucocytes. It remains to notice in few words the parallel process of exudation of liquor sanguinis. The idea that the escape of liquid from the blood into the inflamed parts is a main characteristic of inflammation is an old one; nor indeed is it very easy to see how it could be overlooked, for the swelling which is one of the four cardinal symptoms could not be otherwise explained. It is, therefore, not worth while to occupy space in stating evidence to show that every inflamed part becomes soaked with a liquid which is derived directly from the circulating blood. Nor is it expedient to refer to the doctrines which prevailed when the microscope was first used as an instrument of pathological research, as to the independent origin of pus-corpuscles and other cellular inflammatory products in exuded blood-plasma, excepting in so far as is necessary in order to explain that when we use the term exudation, we mean simply the *act* by which the liquor sanguinis sweats out of the vessels, not either the exuded liquid nor the structural elements which were at one time supposed to be spontaneously generated in it. The important relations of exudation with the other phenomena of inflammation will be fully considered under other headings.

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* I am aware that Prof. Cohnheim has since expressed himself much more positively than in the passage referred to. It is therefore the more important to show what impression was left upon his mind by the facts at the time he observed them.

Part III.—Stasis.

Another change occurs in the blood-vessels in inflammation, which, as it is subsequent as well as subordinate to those already mentioned, has not yet been adverted to. We have seen that in the mesentery as well as in the tongue of the frog, the vascular enlargement which is produced by irritation is for a certain time associated with an acceleration of the blood-stream, or at all events with no appreciable diminution of its velocity; but that, at an uncertain moment, the current begins to slacken, while the leucocytes hug the vascular wall and finally find their way out. If the part is arranged for observation in a manner conducive to the maintenance of the circulation, the retarded current may go on for a long time without any material alteration; but eventually it is apt to become slower and slower and more and more oscillating, until it ceases, in which case the condition long known as stasis is brought about. This does not, however, consist merely in arrest of the current, for it is observed that in those vessels in which stasis has occurred, the blood is not merely motionless, but much altered in its aspect. It appears as if it were made up entirely of coloured corpuscles without liquor sanguinis, and these are packed together in the choked capillaries in such a manner that their individual forms are scarcely distinguishable. The nature of this change was most carefully investigated by Professor Lister in his well-known paper 'On the Early Stages of Inflammation.'* The principal results of his inquiries are as follows:—He believes that the accumulation of the corpuscles is due to a property they themselves possess of cohering together; and that they attach themselves to each other in the inflamed vessels in exactly the same way that they cohere in rolls in ordinary blood after its removal from the body. He does not, however, suppose that this cohesiveness of the corpuscles is greater in the blood of inflamed parts than in other blood;† for he finds in the first place that vessels leading to or from areas of stasis manifest no tendency to cohesion on the part of the corpuscles; and, secondly, that blood taken from inflamed parts differs in no respect from healthy blood, as regards the mode in which its corpuscles arrange themselves on the object-glass. These facts seem plainly to indicate that the cause of the phenomena is to be looked for, not in the condition of the blood, but in that of the vessels—in other words, that the corpuscles draw to each other, not because they are themselves in an abnormal state, but because the living tissue by which they are surrounded is altered. This conclusion is rendered even more certain by the recent experiments of Dr. A. Ryneck in the Physiological Laboratory at Gratz. He has shown that all the phenomena of stasis can be produced by irritation in the webs of frogs, in which milk or defibrinated blood of mammalia has been substituted for the circulating fluid. To demonstrate this, fresh milk must be injected under a pressure of from two to three inches by a canula into the *bulbus aortæ* of a curarized frog, the *sinus venosus* having been previously opened. The milk having passed through the systemic circulation, finds its way out at the venous opening, completely displacing the natural contents of the vessels. If, then, the web is touched with a rod moistened with ammonia, the phenomena of stasis occur in the irritated part; the capillaries become crowded with milk-globules, exhibiting the appearance of grey cords. When defibrinated blood is used, the results are even more striking, for in this case the choked vessels soon exhibit in every respect the same appearances as in ordinary inflammation.

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* *Philosophical Transactions,* 1858, p. 645.

† Loc. cit., p. 669. 'The adhesiveness which the red corpuscles acquire in inflammatory congestion, though varying in proportion to the degree of irritation, is never greater than occurs in the blood of a healthy part when withdrawn from the body.'

These results seem to make it perfectly clear that the local changes which lead to the production of stasis must have their seat either in the walls of the vessels, or in the tissues which immediately surround them. To determine this more precisely, Dr. Ryneck varied this experiment by first filling the vessels with an indifferent liquid, such as solution of common salt of proper strength, so as to remove the blood; then subjecting their internal surfaces for a few moments to an agent which, by virtue of its chemical action, might be expected to modify or destroy its vitality; and finally, after replacing the injurious liquid by milk or defibrinated blood, observing the effects of local irritation. Solution of chromic acid, chloride of gold, and sulphate of copper, were found to be well adapted for thus acting on the vessels. The results were decisive. No stasis was produced by irritation in webs which had been thus treated.*

PART IV.—STRUCTURAL CHANGES IN THE CAPILLARIES.

UNTIL a few years ago, it was supposed that the capillaries take no part in normal or abnormal nutritive processes, excepting in so far as they act as passive filters through which liquor sanguinis transudes. This belief was first shaken by the discovery of Stricker that when the capillaries of the *membrana nictitans* of the frog are examined alive (i.e. when the structure is placed under the microscope in aqueous humour immediately after excision), they exhibit changes of form and size which can only be accounted for by supposing them to be contractile.†

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* Ryneck, *Zur Kenntniss der Stase des Blutes in den Gefässen entzündeter Theile.* Rollett's *Untersuch. aus dem Institute für Phys. u. Histol. in Graz.* Leipzig, 1870, p. 103.

† Stricker, *Ueber die capillaren Blutgefässe in der Nickhaut des Frosches.* Sitzungsberichte der Wiener Akademie, 1865, vol. li. part ii. p. 16. *Studien über*

The activity of the life of the capillary wall has been more completely demonstrated by the further researches of the same pathologist, especially those carried out by him in combination with Leidesdorf, as to traumatic inflammation of the substance of the brain.*

In his first inquiry, published in 1866, Stricker showed that in the brain of the common fowl, when examined five or six days after mechanical injury, the vessels of the injured part exhibit changes which may be best described as consisting in budding or sprouting of the capillary wall. The structureless or hyaline substance of which the capillary appears to consist, is found to have undergone thickenings here and there of such a nature, that instead of being evenly cylindrical, it exhibits projecting irregularities or knobs. Of these knobs some retain their original form, while others grow out into branched or undivided processes, in a direction at right angles to that of the capillary, which sooner or later unite with similar outgrowths springing from other capillaries, so as to give rise to a connecting mesh-work of fibres. In the early state all these formations are beset with numerous fat granules, exactly similar to those which exist in the well-known exudation-corpuscles of inflamed brain substance; so that wherever the knobs are of a globular form, they look as if they were exudation-corpuscles, embedded in and continuous with the substance of the capillary. Very recently these observations have been repeated by Dr. Jolly of Munich,† under Professor Stricker's guidance, who has found that the alteration of the capillaries begins within a day after the injury. The first change consists in an infiltration of the capillary wall with fat granules, and has its principal seat in the neighbourhood of the nuclei. As the process advances, the granulation increases, and the alterations of form already described begin to manifest themselves.

Although a similar process has not been made out in other tissues when in a state of inflammation, there are various facts relating to the condition of the capillaries in such tissues, which are in accordance with it. Thus in the process of healing by the first intention, the formation of new vessels takes place by a

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den Bau und das Leben der capillaren Blutgefässe, loc. cit. vol. lii. part ii. p. 379.

* Leidesdorf und Stricker, *Studien über die Histologie der Entzündungsherde.* Sitzungsb. der Wien. Akad. vol. lii. part ii. p. 534.

† Jolly, *Ueber traumatische Encephalitis.* Stricker's *Studien,* 1870, p. 38.

mode of budding from the old capillaries, which is very like that we have been considering. Little processes sprout out from capillary loops in the neighbourhood of the wound, which are still entire, and grow towards similar processes which spring from other loops. The two growing points, as soon as they come into contact, melt together, just in the same way as the growing ends of the marginal filaments which we studied before in the plasmodium of the myxomycetes. Thus the main difference between the process of healing and that of traumatic encephalitis lies in the circumstance that in the latter the outgrowths from the capillaries are apparently not tubular, and do not become vessels. So also in the pyogenic membranes of very small abscesses, the newly formed capillaries, although they become looped, originate by outgrowth in the same manner.*

Since the discovery of the emigration of blood leucocytes, it has often been argued that their escape from the capillaries would not be possible unless the capillary membrane were porous; and then, this being admitted, the fact that the capillaries can be filled to distension with transparent injection-masses (such as the so-called soluble prussian blue) without the slightest extravasation, has been used as a reason for regarding migration as an impossibility. There seems to me to be no doubt that if the porosity of the capillaries were a necessary inference from the fact of emigration, the objection made would be a valid one. But from the account which has been already given of the vital properties of the capillary substance, the reader will see that any such assumption would be premature. The capillary is not a dead conduit, but a tube of living protoplasm. There is therefore no difficulty whatever in understanding how the membrane may open to allow the escape of leucocytes, and close again after they have passed out; for it is one of the most striking peculiarities of contractile substance that when two parts of the same mass are separated, and again brought into contact, they melt together as if they had not been severed.†

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* For a full description of this subject, see Wywodzoff, *Experimentelle Studien über die Vorgänge bei der Heilung per primam intentionem. Medizinische Jahrbücher*, 1867, p. 3.

† 'The griding sword with discontinuous wound
Passed through him, but th' ethereal substance closed
Not long divisible . . . . . .
. . . . for spirits that live throughout

Part V.—Summary.

We have now arrived at a point in our inquiry at which we may perhaps advantageously pause, and endeavour to bring the various parts of the process we have considered into closer relation with each other.

We have learnt that in inflammation the circulation is at first accelerated and increased, subsequently retarded and diminished, that the latter condition is attended with exudation of liquor sanguinis, emigration of leucocytes and stasis. In the study we have already made of these phenomena we have been led to believe that their origin is partly local, partly general. Thus, with respect to the leading vascular change in inflammation, viz. the acceleration of the blood-stream, it has appeared to be established on satisfactory grounds that it is a consequence of an impression received by the centripetal nerves of the injured part, and reflected by the vaso-motor centre through the centrifugal nerves to the vessels; so that, although our understanding of the mechanism by which this result is brought about is as yet very imperfect, we can have little doubt that it is due to changes having their seat in the nervous system. On other grounds we have seen reason to suspect that most of the subsequent phenomena have no direct relation to the dis-

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Vital in ev'ry part, not as frail man,
In entrails, heart or head, liver or reins,
Cannot but by annihilating die;
Nor in their liquid texture mortal wound
Receive, no more than can the fluid air.
All heart they live, all head, all eye, all ear,
All intellect, all sense; and as they please,
They limb themselves; and colour, shape, or size
Assume, as likes them best, condense or rare.'

Paradise Lost, Book vi.

Since the above was written I have had the opportunity of witnessing the very admirable and ingenious experiments lately exhibited at the Royal Society by Dr. Norris. A membranous film is formed by dipping a metal ring, a foot or more in diameter and held horizontally, into a vessel containing solution of soap. It is then shown that soap-bubbles, glass rods, and other objects with wetted surfaces, can be pressed through the film without its being ruptured. The conditions of this experiment are so entirely different from those which exist in the living tissue, that I cannot regard it as affording any explanation of the passage of leucocytes through the walls of the capillaries.

turbance of the circulation as their cause, but rather to intimate changes in the properties of the living substance with which the blood comes into contact in its passage through the affected part. We shall probably best accomplish the end we have in view by assuming in the first instance that the essential phenomena of inflammation are referable either to disordered vascular innervation or to a local disturbance of the life of the inflamed part. We shall then be able to consider, with respect to each of them in succession, in how far it is referable to one or other of these proximate causes. The assumption, even if it do not turn out to be a true one, will materially help us in bringing facts into connection, and in determining their relative significance.

We have first to inquire into the causes of the slowing of the blood-stream which always succeeds the primary acceleration. Does it happen because the access of blood from the heart is retarded? or is it a combined result of the subsidence of the previous acceleration and of dilatation of the smallest vessels? The main reason for believing that it is due to diminished supply of blood from the heart, and therefore presumably to a condition of the arteries the reverse of that which leads to the previous afflux, is that in certain cases it is attended with visible narrowing of the arteries. The most positive observations on this point are those of Saviotti already referred to. He has made careful comparative experiments as to the vascular effects produced in the web of the frog by acids, alkalies, metallic salts, neutral alkaline salts, croton oil, cantharides, and other irritants; and he finds that in every case the diminution of the capillary circulation is attended with narrowing of the afferent arteries. Just as in the case of the previous dilatation, however, the relation between contraction of the capillaries and slowing of the blood-stream is not constant either as regards their degree or the time at which they occur. This want of correspondence is in itself sufficient to show that the former canot be regarded as the cause of the latter. And we are the more disposed to adopt this view when we consider that the contraction can be completely accounted for otherwise. During the primary afflux of blood the arterial dilatation extends not merely to those branches which lead directly to the inflamed area, but to those which convey blood to its immediate neighbourhood. Soon, slowing and stasis occur at the centre, the increased afflux still continuing, in consequence of which the collateral capillary channels become more and more enlarged. Eventually the arterial determination of blood subsides: less blood flows, but the capillaries still remain open, and therefore the artery which feeds them having less resistance in front, contracts to a diameter smaller than that which it originally possessed. In other words, notwithstanding the obstruction which exists at the seat of inflammation, the effect produced is not, as might be expected, dilatation, but contraction of the afferent artery, because the resistance is far more than balanced by the increased facility of circulation in the surrounding zone of congestion; so that the pressure of the blood against the inner surface of the artery, and consequently its expansion, is considerably lessened. The diminished circulation in an inflamed part is therefore not to be regarded as a consequence of the diminished afflux of blood *a tergo*; for the narrowing of the arteries is a merely secondary effect of the disturbance of the circulation. We must, therefore, in accordance with the assumption with which we started, look in the direction of the local changes for its cause.

It follows from what has been said that the slowing of the capillary circulation is merely the first stage of stasis, the beginning of the process of which stasis is the end. For if it be granted that they are both of exclusively local causation, it would be unreasonable to separate them; the more so considering that in all cases in which we have the opportunity of observation, the former is found to pass by insensible gradations into the latter. So far, therefore, as relates to the local changes in inflammation, i.e. to those which occur within the range of the immediate action of the injurious stimulus, we see that the process consists first in gradual arrest of the capillary circulation, and secondly in exudation of certain constituents of the blood. When we proceed further to inquire in what relation these two stand to each other, by comparing the circumstances under which they are actually observed, we come at once to the conclusion that they are so closely and inseparably associated that neither can be considered as consequent or antecedent, and hence that both must be dependent on the same proximate cause.

In the present state of our knowledge it is not possible to elucidate the nature of this cause completely. There are, however, certain experimental facts which enable us to approach its solution somewhat closely, and which will, on this ground, serve as a basis for future investigation. Thus, if a ligature is tightened round the thigh of a frog, so as to arrest the circulation, and ammonia is applied to the web, the blood gathers from all sides towards the irritated part, until the capillaries within the area of irritation become choked with closely packed blood-corpuscles, and present all the appearance of stasis. If at the same time the other web is irritated in a similar manner, a comparison can be made of the effects produced. So far as the state of the capillaries is concerned, there is no difference whatever between them; the similarity becoming still more striking if the circulation is restored in the ligatured limb by removing the thread. Both webs then exhibit the ordinary results of irritation.*

In this experiment we have the process of inflammation reduced to its simplest form. Taken in combination with the observation of Dr. Ryneck, related in Part III., that neither exudation nor arrest of the capillary circulation can be produced in vessels through which certain poisonous metallic solutions have been passed, it shows that the agent in all the visible local effects is the living substance with which the blood comes into contact as it flows. Beyond this point we lose the guidance of direct observation, and must for the present content ourselves with stating that in an injured part the walls of the capillaries become so altered that the liquor sanguinis, instead of transuding from the smaller arteries in quantity just sufficient to balance the absorption, leaks abundantly from the vessels; and that in many cases this is subsequently associated with squeezing out of the leucocytes, or even of the coloured corpuscles.†

What the nature of this sudden change in the living substance is, we know not, and should gain nothing by speculating. Apart from all theory the fact stands out clearly that, independently of any visible alteration either in the vessel itself or in the structural elements in its neighbourhood, the constant effect of injuring a living tissue is to divert a part of the liquor sanguinis from its natural course, and determine its soakage from the vessels which before held it, into the surrounding parenchyma.

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* This experiment was first made by H. Weber in 1852 (*Experimente über die Stase an der Froschschwimmhaut.* Müller's *Archiv*, 1852, p. 361). It was repeated by Prof. Lister (loc. cit. p. 667) in 1857, and subsequently by other pathologists.

† That the change by which the capillaries become leaky has its seat in the vascular walls rather than in the adjoining tissue, is rendered probable by a recent observation of Dr. Ryneck, who has found that if an irritant is applied to the web of a frog, in which solution of common salt is circulating instead of blood, it becomes infiltrated at the seat of irritation to such an extent that a prominent tumour is formed, which eventually spreads over the whole of the division of the web acted upon. This experiment shows that exudation cannot be a consequence of increased attraction between the tissue and the circulating liquid, for in the case of salt solution such an attraction cannot be supposed to exist.

Another question presents itself, the consideration of which cannot be left out, although it does not at present admit of any satisfactory answer—viz. that of the immediate cause of the emigration of leucocytes, and the relation of this phenomenon to exudation of liquor sanguinis. Why, as the blood-stream slackens in an inflamed part, leucocytes should separate from it and tend towards the internal surfaces of the veins and capillaries, we must admit ourselves altogether unable to explain. The fact that if blood freshly taken from the circulation of a frog or newt is received in a capillary tube or under a cover-glass, the leucocytes emigrate from the clot as soon as it is formed, and collect in numbers in the surrounding serum, affords an opportunity of watching the process under conditions much simpler than those which exist in the circulation.* As yet we are as little able to explain the one as the other. There can, I think, be little doubt that of the two stages in the process of emigration—viz. the long known loitering of leucocytes along the sides of the vessels, and the newly-discovered penetration by them of the vascular walls—the first is the essential one, and that whenever an explanation is found of the former, it will serve as a key to the comprehension of the latter.

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* For a description of this process see my lecture on *Leucocytes,* already quoted.

SECTION II.—CHANGES WHICH HAVE THEIR SEAT IN THE TISSUES.

Introduction.

In the preceding section we have seen that the process of inflammation centres in the discharge of liquor sanguinis from the capillaries. We have now to consider the influence which the exuded liquid exercises on the elements of the tissues. The textural changes, although they may differ considerably according to the structure and function of the part affected, are all of such a nature as to indicate increased activity of cell life. Considering that the condition of an organ which is the seat of inflammation differs, so far as observation teaches us, from the ordinary state only in being soaked with exuded liquor sanguinis, it is natural to attribute the supervening over-growth and over-multiplication of cells to the exudation. As, however, many pathologists believe that these effects have an extremely different signification—that they are the results not of the direct stimulation of the cells, but of impressions reflected to them by an unknown nervous centre, supposed to preside over nutrition—we shall, after we have completed those anatomical descriptions which will constitute the most important part of the present section, place before the reader the grounds which exist for believing that whatever other influences may co-operate with that of changes in the nutritive medium in which the tissues are immersed, this is in itself sufficient to account for the textural germination. (See Part III.)

Part I.—Structural Changes which occur in the Connective and Supporting Tissues in Inflammation.

Under this title I include all those tissues which are not concerned in any function excepting those expressed in the definition. With reference to the present inquiry they are divisible into vascular and non-vascular. The vascular tissues include bone and the varieties of connective tissue in the strict sense; the non-vascular, cartilage, tendon and the cornea.

Non-vascular connective and supporting tissues.

In studying the process of inflammation in tissues which derive their supply of nutritive material from blood-vessels at a considerable distance, we have the great advantage of being able to separate entirely those phenomena which are proper to the tissue-elements from those which belong to the circulation. For this reason it is not surprising that the non-vascular tissues have at all times, since the earliest attempts to apply exact methods of research to pathology, been favourite fields for this investigation, and that of late years in particular, the most fruitful and at the same time decisive discussions which have taken place have related to the structural changes produced by artificial irritation in the cornea.

Inflammation of the cornea.—The reader who desires to know more of the earlier researches relating to traumatic keratitis will find the information he requires in special treatises on that subject. For the elucidation of the question which now engages our attention it appears scarcely necessary to carry our inquiries beyond the past ten years; for the better modes of investigation which have been introduced since 1863 by v. Recklinghausen and Cohnheim have given to subsequent observers so great an advantage over their predecessors, and placed the subject in a light so entirely new, that it has become necessary to begin the work afresh. The result has been to confirm the truth of the previous discoveries, and to establish the doctrine of textural pyogenesis, which was so admirably developed in the article on the process of inflammation contained in the previous edition of this work, on a more solid and extended basis.

Professor von Recklinghausen's method of examining the cornea of the frog is as follows: * The anterior chamber is first punctured so as to let out a drop of aqueous humour, which is placed on the object-glass; the cornea is then excised and placed in the drop with Descemet's membrane uppermost. The preparation thus obtained is examined without a cover-glass, in a closed chamber in which the air is saturated with moisture, so that no evaporation can take place, and consequently no alteration in the density of the liquid in which the cornea is immersed.* The healthy cornea is absolutely transparent, and when it is examined under the microscope in the manner described, no structure can be distinguished. This homogeneity, so essential to the function of the cornea, is a condition inseparable from life; if the observation is continued till the tissue begins to die, its structural elements gradually come into view—first the epithelia, then the lymphoid elements proper to the tissue, then the cornea-corpuscles. The explanation of the fact is, that whereas in life the elements of which the cornea is formed, affect light exactly in the same degree, their respective refractive powers are slightly altered in the act of dying.

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* V. Recklinghausen, loc. cit. p. 157.

If a cornea is examined in the same way, which has been irritated a quarter of an hour before by the application of a point of caustic to its surface, the conjunctival epithelial layer can at once be distinguished, along with a few leucocytes, underneath and among the epithelial elements. If an hour or two has elapsed, the proper cornea-corpuscles are visible, as dark stellate or spindle-shaped spots on a transparent ground. Of these some are homogeneous, and can be distinguished from the surrounding substance by a slight difference of shade. In others, which are finely granular, the processes or rays are subject to slight variations of contour. These amœboid movements of the rays, although very sluggish as compared with those of young protoplasm in general, are rendered much more active by subjecting the preparation to a stream of blood-serum; for which purpose Professor Stricker employs the serum of the same animal which has furnished the cornea.

In order to follow the inflammatory process in its further stages, another method of preparation has been found by Stricker to be advantageous. The cornea is immersed for a few minutes in a weak solution of chloride of gold (½ per cent). It is then washed with water slightly acidulated with acetic acid, and exposed to daylight. When the frog's cornea is examined in this way at various periods after irritation, the progress of the changes of which the beginning has been already sketched, may be studied with great advantage. In the normal cornea, when so treated, the stellate corpuscles with their nuclei can be very distinctly seen. The latter are irregularly defined, of large size in relation to the protoplasmic mass in which they are embedded, and contain one or two nucleoli. In the stellate masses themselves the caudate processes or rays are the most striking and obvious features. In a cornea excised three hours after irritation, some of the corpuscles exhibit no change excepting that their outlines are more strongly marked ; in others there seem to be, in addition to the irregular nucleus above referred to, one or more spheroidal bodies which are embedded in some other part of the corpuscle. This appearance affords the earliest sign that the process which has been hitherto called 'proliferation' is beginning, that is to say that the mode of life of the protoplasmic mass is changing from the normal quiescent state which fits it to take part in a permanent tissue, to the state of reproductive or germinating activity—that new bodies are being formed within the body of the parent mass, to which such terms as 'germs' or 'offspring' are applicable. A part of the original living substance of the element begins a new life, much more active than it before possessed, and a new organic development. Since the introduction of the method of observing structural changes in living tissues, pathologists have learnt that it is a constant characteristic of the change we are considering, that the rejuvenescent part or

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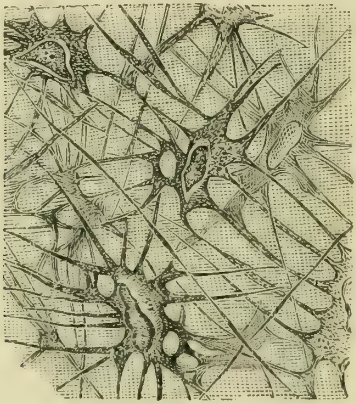
* The following statement is founded on the admirable research of Mr. W. F. Norris, conducted in the Vienna laboratory under Stricker's guidance. Norris and Stricker, *Versuche über Hornhaut-Entzündung.* Stricker's *Studien*, 1870, p. 1. I retain the terms employed by the authors, although in the light of more recent anatomical discoveries they are open to criticism.

Fig. 400.

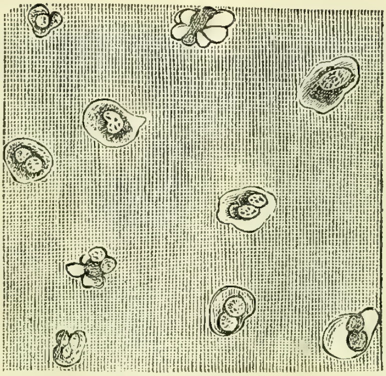


Cornea of frog excised three hours after irritation.

substance acquires the property of contractility. In other words, that all protoplasm when assuming new life, and beginning new organic development, is endowed with the faculty of amœboid movement. Of the words which have been employed to denote this change, viz. rejuvenescence, proliferation, germination, the last appears preferable as being the least technical and the most expressive.

We return to the further steps of the germinative process in the inflamed cornea. Between the fifth and twelfth hours after irritation the cornea-corpuscles become more and more distinct and granular, while their processes become thicker and shorter, until at length many of them lose altogether their characteristic stellate, or caudate, outline, and are converted into irregular clumps. If the cornea is examined in this stage, after treatment with chloride of gold, it is seen that in those parts in which the structural changes are most advanced the normal character of the tissue is entirely lost. The beautiful network produced by the interlacing of the normal corpuscles is no longer visible; in place of it the field is scattered over with clumps of irregular form, in some of which the caudæ are represented by rounded knobs, while in others the outline is almost spheroidal. Most of these bodies are so granular that their contents cannot be distinguished, but in others the newly formed germs are plainly visible. The number of these germs varies according to the stage of irritation, so that in the same cornea, clumps containing a numerous offspring may be seen in one part, while in others the germination is only beginning.

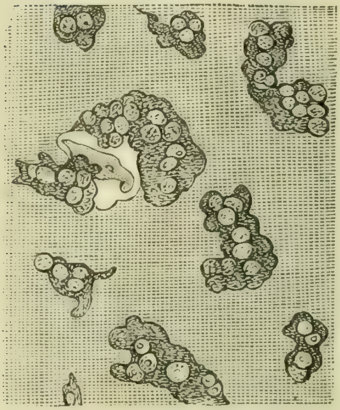
FIG. 401.



Altered corpuscles of cornea excised eight hours after irritation.

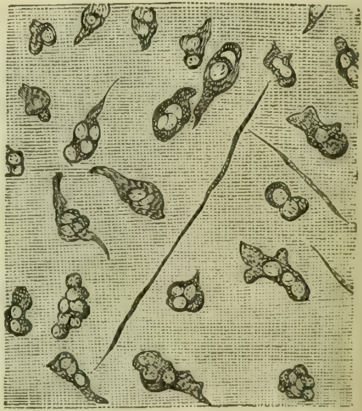
That the interpretation suggested by these appearances is the true one, that the clumps containing numerous round corpuscles are really of the nature of mother-cells, the observer can best assure himself by returning to the method of examination first described, that is to say by placing the inflamed tissue under the microscope alive, at the same time stimulating the elements in question to increased amœboid movement by irrigation with serum. It is then seen that the germs change their relative position with the movements of the mass of protoplasm in which they are enclosed, just in the same way as the granules and ingesta do in the body of an amœba, rolling one over another in such a manner as would not be possible if they were not really contained in the mass.

FIG. 402.



Cornea sixteen hours after irritation. Amœboid masses containing numerous newly formed elements.

FIG. 403.



Cornea about twenty-four hours after the insertion of a fine ligature. Masses containing young elements in the neighbourhood of the thread.

Hitherto nothing has been said of pus-corpuscles, that is leucocytes, because in the stages of keratitis we have been considering they bear no part. The cornea has lost its perfect transparency, but is not as yet turbid; the few leucocytes which are met with are those which are indigenous in the tissue. There is as yet no suppuration; to arrive at an opinion as to how the formation of pus commences we must follow Professor Stricker a stage further. The difficulty of the observation lies in the rapidity with which the process takes place; for from the moment that the cornea begins to be clouded, its tissue is so beset with growing and multiplying elements that it is difficult to distinguish them, so that the only way by which a conclusion can be arrived at is by combining the results of a number of observations made on different corneas at the stage of commencing opacity.* From such observations it may be learnt, first that the opacity is due to the presence of leucocytes which are so numerous that it is out of the question to regard them as the offspring of those which are indigenous in the tissue; and secondly, that among them there are many of the original branched or stellate corpuscles, some of which are only slightly changed in outline or aspect. But in addition to these more or less normal corpuscles, the masses above described, containing groups of germs, also occur in great numbers, while among them, and in the very parts of the cornea where they are most numerous, the leucocytes are most crowded and there are fewest fixed corpuscles. If these are facts it can scarcely be doubted that there is a relation between the metamorphosis of the stellate corpuscles and the formation of leucocytes; in short, that the little spheroids which are contained in the amœba-like masses are young pus-corpuscles, and that even in the cornea suppuration must be regarded as at all events in part, a process of germination.

We have next to consider to what extent emigration is also concerned in traumatic keratitis. According to Professor Cohnheim, it is the only way in which the pus-corpuscles are produced, this conclusion being mainly founded on negative observations. He has failed to observe the germination process we have been describing, and does not believe in it. He finds that in every form of traumatic keratitis, whatever be the nature or mode of application of the irritant, the stellate corpuscles remain absolutely unaltered, both as regards their position and arrangement, and their structure, and that the leucocytes to which the opacity is due are neither enclosed in other elements nor show any indication of being in different stages of development; whence he naturally concludes that they cannot have originated where they are found, and must have been introduced from outside. He has further observed, and the fact has been confirmed by many other pathologists, that if keratitis is produced in a frog whose blood-leucocytes have been charged or fed with aniline or vermilion by injecting either of these pigments in a state of extremely fine division into the circulation, corpuscles can be distinguished in the inflamed cornea, which from their being pigmented must necessarily have migrated from the blood. In some cases the marginal part of the cornea, that part which of course is nearest to the vessels, is so full of immigrant leucocytes that the blue or red coloration can be distinguished even with the naked eye. These facts of course afford conclusive evidence of migration, but they contain no disproof of tissue-germination, for even Professor Cohnheim himself admits that in all stages of the process there are many leucocytes which are not coloured.

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* The reader who is acquainted with Professor Cohnheim's researches on keratitis will notice that they commence at the point to which we have now reached, so that it is not difficult to understand that, although he employed the same modes of examination, he failed to observe the structural changes which have been described in the preceding paragraphs.

The only positive argument against germination is that founded on the remarkable experiment known as that of the 'salt frog.' This experiment consists in slowly injecting a weak solution of common salt by the abdominal vein, until blood ceases to flow from its peripheral end which is left open, so that the whole of the natural circulating fluid is replaced by the saline solution. In this condition the animal may be kept alive for several days. If then, immediately after the injection, the cornea is irritated, no opacity is produced, because, according to Cohnheim, the blood from which they spring is absent. During last summer this experiment was carefully investigated in the Vienna Pathological Laboratory. It was found that even if the injection is continued, according to Cohnheim's direction, until the liquid which issues from the open end of the vein appears colourless, the minute capillaries as seen in the mesentery still contain liquid which is rich in leucocytes, so that whatever be the explanation of the want of opacity of the cornea, it is not due to the absence of these structures from the circulation; it is much more reasonable and natural to suppose that the result of the experiment is to be accounted for by the peculiarly abnormal condition of the animal.

Inflammation of cartilage.—The changes which occur in the permanent structural elements in consequence of irritation, are much more easily studied in cartilage than in the cornea, on account of the facility with which this tissue can be prepared for microscopical examination; it has therefore from the commencement of the inquiry afforded to the pathological observer the most accessible evidence in support of the belief that such structural changes form an essential part of the process of inflammation; and particularly as regards the question of the origin of pus, the obvious difficulty of supposing that the young elements which occupy its cavities when it is inflamed have penetrated into those cavities from some other quarter, has made the case of cartilage the strongest that can be cited against any exclusive doctrine of emigration. For this very reason it is unnecessary to devote much space to the discussion of inflammation in cartilage, for it is certain that if we can show that germination is the rule in every other tissue, no one will suppose that cartilage is an exception. The normal cartilage cell, like every other active cell, is a mass of protoplasm containing a nucleus. As in the case of the cornea, each mass is enclosed in a cavity of similar form to itself, which is hollowed out in the interstitial substance; the difference being that whereas in the cornea the cavities communicate with each other by the innumerable tubular prolongations which correspond to the rays of the stellate cells, in cartilage they have no such prolongations and are entirely closed. When cartilage is irritated, as for example by scraping its surface, the cells in the neighbourhood of the irritation enlarge and consequently expand their capsules. The protoplasm of which each cell consists becomes more granular, and soon it is found that the mass contains two corpuscles in its interior instead of one, and that each has a gathering of protoplasmic matter around itself. This process of division is repeated in each segment until every cavity contains a mass of nucleated cells, which at length assume characters corresponding with those of newly formed pus-corpuscles, while at the same time the original interstitial substance gradually wastes away, and is finally represented by a sponge-like stroma, in the holes of which the groups of young cells are contained. In this process we have a typical example of germination; the permanent cells which have for their function the maintenance of the unchanging life of the tissue, are replaced by a more numerous progeny of transitory mobile cells—i.e. leucocytes—which live at the expense of what remains of the tissue and eventually destroy it.

Inflammation of tendon.—As a non-vascular tissue, extremely rich in cellular elements, tendon has almost as great advantages as cartilage for the study of the inflammatory changes which such elements undergo at a distance from the vessels. The splits (*Henle'sche Spalten*) which exist in tendon between the parallel bundles, are lined with chains of staff-shaped, nucleated cells, each of which is in contact with its neighbours by its ends, and consists of a cylinder of protoplasm, including a nucleus. The changes which these cells undergo have been recently very completely studied in rats and guinea-pigs by Dr. Güterbock, who finds that by a kind of cleavage of the nucleus that body assumes a botryoidal or necklace form, to which the scanty covering of protoplasm models itself. Eventually new cells (young pus-corpuscles) are formed by the complete division of the nucleus. Here, as in other cases, the participation of the elements of the tissue in the germinative process, can only be judged of at the very beginning, i.e. about eight hours after the injury. At a later period it is so difficult to distinguish the results of similar changes in the connective tissue from those proper to the tendon itself, that no conclusion can be arrived at.*

Vascular connective tissue.

The most positive information we possess as to the nature of the inflammatory changes in vascular connective tissue is derived from the examination of the process in the frog's tongue, for there is no other organ in which the tissue in question can be placed under the microscope under conditions so completely normal. The mode of experiment has been already referred to.

The textural changes have been lately described with great minuteness by Professor Cohnheim,† and still more recently his description has been critically examined by Professor Stricker.‡ The curarized frog is conveniently placed on its back, the tongue being extended by a ligature attached to each of its two tips, and the ligatures so fixed that the organ can be set free and replaced in the mouth at the end of each period of observation. The tongue can thus be placed readily under the microscope, with its papillary surface upwards. As, however, the submucous tissues could not be well seen through the mucous membrane, it is desirable to strip this membrane off, over a small extent of surface, an operation which can be effected with scarcely any bleeding, and has the additional advantage that it affords a convenient and practical method of irritating the parts to be examined. If these preliminary arrangements have been successfully carried out, and sufficiently high powers are employed in the examination, it is seen that in the meshes between the capillaries of the inter-muscular spaces there are bodies of the most varied form and slightly turbid appearance—the so-called connective-tissue-corpuscles. According to Cohnheim these bodies take no part whatever in the inflammatory process, the steps of which, as he observed it, correspond to those we have already described when speaking of inflammation in the mesentery. To determine this question, of such importance in its general bearing on inflammation of connective tissues, Professor Stricker has subjected these corpuscles to the closest scrutiny. He finds that while some of them are oblong or fusiform, others are of the extremely irregular form figured by Cohnheim, and that corpuscles of the latter class may be watched for hours (in one instance in the same individual for ten hours continuously) without changing their place. But he does not admit that they are motionless; on the contrary, he states that they undergo changes of form of so marked a character, that there can be no mistake about their existence. Thus they swell at one part, shrink in others, sometimes budding out into processes, which are again retracted; at others assuming forms which seem to indicate that they are on the point of dividing. Yet notwithstanding the most careful and patient observations, Stricker has not succeeded in seeing a single act of division completed. In the oblong corpuscles the amœboid changes are less active, and limited to the extremities. Sometimes it was observed that the tip gathered itself up as if it were just

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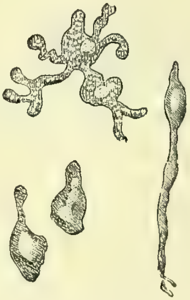
* Güterbock, *Untersuchungen über Sehnenentzündung.* Stricker's *Jahrbücher,* i. p. 22.

† Cohnheim, loc. cit. p. 344.

‡ Stricker, *Ueber die Zelltheilung in entzündeten Geweben,* loc. cit. p. 18.

FIG. 404.



Connective tissue corpuscles of the tongue of the frog.

about to separate from the rest, but again subsided into its original condition.

In several of Stricker's experiments the process of emigration was going on with great activity, and the tissue becoming fuller and fuller of leucocytes during the whole period that he was engaged in observing the phenomena above described in the connective-tissue-corpuscles. It therefore appears perfectly clear that, in the particular case of the tongue of the frog, these corpuscles have at first nothing to do with the process of suppuration. On the other hand it seems highly probable that if it had been possible to pursue the investigation to a later stage, the changes of form which he describes would have resulted in actual division. The lesson to be learned here, as in other cases, seems to be, that although in acute and rapid suppurations the leucocytes are mostly if not all emigrants, there is reason to believe that at later periods other modes of pyogenesis come into operation. At the same time it must be borne in mind, that in the present state of our knowledge this is rather a matter of inference than of observation. The grounds for believing it are in the first place the facts we have already considered with reference to the cornea, and secondly the structural alterations which are met with in examining tissues in the more advanced stages, and less acute forms of inflammation—all those anatomical facts, in short, which formed the original groundwork of the doctrine hitherto taught of the textural origin of pus ; with reference to which many of Cohnheim's followers seem to have forgotten that they are quite as true and quite as significant as ever. For in every limited inflammation of the subcutaneous tissue, and in the neighbourhood of every subcutaneous abscess, a region is found outside of the focus of suppuration, in which the connective-tissue-corpuscles present alterations which are so distinct, that it is impossible for any one who is conversant with them to doubt that they signify that the tissue is germinating.*

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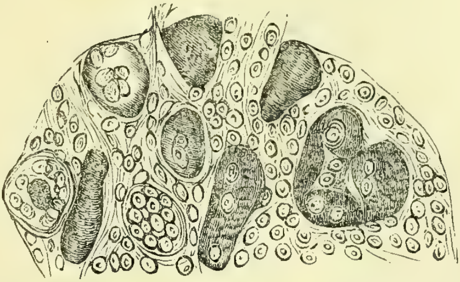
* The experiment of M. Lortet, already referred to (p. 750), affords the pathological student the opportunity of satisfying himself, by a single observation, that in traumatic inflammation of the subcutaneous cellular tissue, pus is formed both by tissue-germination and emigration. The swimming-bladder of a fish, previously filled with solution of common salt, is inserted beneath the skin of a rabbit. After thirty-six hours the animal is killed, and the lesions are investigated. It is then seen that while the bladder is full of corpuscles which can only have migrated from the blood vessels, there is abundant evidence of the commencement of germinative pyogenesis in the surrounding texture.

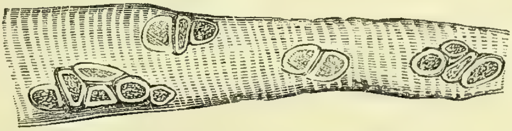
Inflammation of muscle.—There is no vascular tissue in which the phenomena of germination can be more satifactorily studied than in muscle. The process was first examined by Waldeyer, and subsequently by Otto Weber (Fig. 405). Still more recently it has been made the subject of an extended series of experiments by Dr. Janovitsch Tschainski,* under the direction of Professor Stricker. In traumatic inflammation of muscle, the fixed corpuscles of the fibre-sheaths undergo alterations which resemble those we have already noticed in connective tissue, and, as in the other case, they are much better seen in parts at a little distance from the seat of injury than in its immediate neighbourhood. Thus, in experiments in which muscle was cauterised, Dr. Janovitsch found that the inflammatory changes could be studied most advantageously in the outer zone of redness and swelling. In this situation the muscular substance, when examined twenty-four hours after irritation, is found to be for the most part unaltered, the transverse striæ

Fig. 405.



Cross section of human muscle from the neighbourhood of a wound. The dark masses represent the remains of muscular bundles. In other parts of the section the sheaths are filled with young elements, which have displaced the muscular substance. The interstitial connective tissue is also in a state of germination. (After Otto Weber).

Fig. 406.



Multiplication of nuclei in the sheath of an inflamed muscular fibre.

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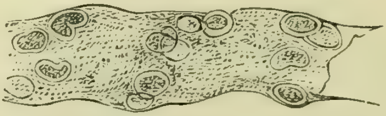
* *Ueber die entzündlichen Veränderungen der Muskelfasern.* Stricker's *Studien,* p. 86.

being well marked and of natural appearance. The aspects of the corpuscles vary according to the stage of change. Some are merely enlarged, each consisting of a single nucleus embedded in a fusiform clump of finely granular protoplasm. Of the rest some exhibit two nuclei, others a greater number, which are arranged either in a heap or in a series, and are generally so close to each other that their opposed surfaces are flattened, the whole being held together and surrounded by the protoplasm already mentioned. In the later stages the young elements multiply to such an extent that they eventually occupy the whole of the sheath, the natural contents having gradually disappeared.

Fig. 407.



Empty sheath beset with young elements.

Part II.—Structural Changes which occur in the Epithelial and Glandular Tissues in Inflammation.

Epithelial tissues.—The appearances observed in suppurating mucous membranes have always been regarded as affording, next to those in the cornea and in cartilage, the strongest evidence of the textural origin of pus. For in a great many kinds of catarrh, large cells have been met with in the purulent liquid which is thrown off at the very commencement of the process, which contain groups of bodies entirely resembling young pus-corpuscles. These remarkable epithelial elements were considered by Buhl,* who first described and studied them, as mother-cells or brood-cells; and most pathologists since have regarded them in the same light. But more recently, since the discovery of emigration has induced a tendency in the minds of some persons to conform all the details of the inflammatory process to one type, Steudener and Volkmann† have maintained that the bodies in question are not the offspring of the cells in which they are enclosed, but strangers which have intruded themselves from without. Here, as in so many other cases, the only way of solving the question was, if possible, to observe the phenomena in the living tissue, i.e. to see the process of intrusion or extrusion actually going on under the microscope. This, however, was evidently a matter of great difficulty. In Professor Billroth's * admirable essay on inflammation the reader will find an account of a number of efforts made by him for the purpose without satisfactory results. The question seems, however, to have been now settled in favour of the original doctrine of Buhl, by the very recent researches of Dr. Oser † in the Vienna laboratory.

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* Buhl, Virchow's *Archiv,* vol. xvi.

† *Centralblatt,* 1868, No. 17.

Although in general epithelial structures derive their nourishment directly from the blood, there are some which are entirely remote from vessels. Of these the epithelium covering the cornea and that of the epiploa are the best examples. If the normal epiploon ‡ of the rabbit or guinea-pig be treated with weak solution of nitrate of silver, and then exposed to the light and examined without further preparation, it is seen that in the most delicate parts it consists merely of a network of hyaline fibres of connective tissue paved on both sides with flat epithelia; and that in the centre of most of them a little mass of protoplasm can be distinguished. We have here, therefore, an epithelial structure of the simplest kind which is entirely out of relation with the capillaries, and is thus remarkably well fitted for studying the independent behaviour of epithelial elements in serous inflammation. If a little iodine or solution of nitrate of silver be injected into the peritonæum, and the omentum be examined twenty-four hours after, it is found that the fibres of the network are no longer covered with a continuous pavement, but that a number of elements hang about it, most of which differ considerably from the original epithelia, though some still resemble them. The most striking difference is that of the increased size of the protoplasmic mass. Instead of a faintly granular body, scarcely so large as a leucocyte, you have a clump twice or three times as large, which if examined under the proper conditions displays

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* Billroth, *Mancherlei über die morphologischen Vorgänge bei der Entzündung. Medizinische Jahrbücher*, vol. iv. 1869, p. 1.

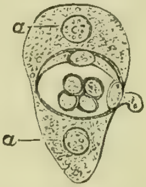
† Oser, *Ueber endogene Bildung von Eiterkörperchen an der Conjunctiva des Kaninchens.* Stricker's *Studien*, p. 74.

‡ Cornil et Ranvier, *Manuel d'Histologie pathologique.* Paris, 1869, p. 74.

amœboid movements. Some of these rapidly growing cells contain single nuclei, others two or a greater number of spheroidal corpuscles corresponding in form and size to those which either float free in the peritonæal liquid, or are enclosed in the coagulum of reticular fibrine with which the affected surface is more or less covered.

In this case it is at all events certain that some of the changes observed have nothing to do with migration, for the membrane in which they occur is non-vascular. But it is obviously only a matter of inference, that we have before us an actual formation of pus by epithelial germination. We shall find, however, additional ground for believing that this interpretation is the true one, by comparing the account given above with the very exact observations of Dr. Oser on the conjunctiva already referred to. In his experiments the membrane in question was examined at periods varying from a few hours to four or five days after irritation with solution of ammonia of various strengths. The first stage of the process consists in the growth of the protoplasmic or living part of the epithelial element, and the consequent disappearance of the external investment; the second in the condensation of the granular material at one, two, or a greater number of points, into little spheroidal corpuscles, which as they become more distinct appear to detach themselves gradually from the remaining granular matter, until eventually they all lie free in one cavity. Finally the spheroids show themselves to be leucocytes by their amœboid movements; and, on one fortunate occasion, were seen by Dr. Oser making their way out of the mother-cell and then moving about in the surrounding liquid.

FIG. 408.



An epithelial element from the anterior surface of the cornea of a rabbit, which had been irritated two days before with weak ammonia. *a a*, Nuclei. One of the five young elements contained in the central cavity is in the act of escaping through the wall of the cell.

In both the cases referred to, it is to be borne in mind that the fact of germinative pyogenesis does not exclude that of migration. Indeed, as regards the serous membranes, there is the strongest reason for believing, that in certain forms of acute peritonitis the leucocytes contained in the peritonæal liquid are all emigrants. Thus in the peritonitis which is produced in the frog's mesentery by exposure, it is quite impossible to suppose that the dense layer of corpuscles which, in the advanced stage of the experiment, covers the surface of the membrane, can be derived from any other source than the circulating blood. Again, the anatomical appearances which present themselves in the most acute forms of suppurative peritonitis with which we are acquainted clinically, even though we may be disposed to admit that they might be brought into harmony with an opposite theory, can be explained much more naturally and easily in the same way.

Glandular tissues.—The question next to be considered is that of inflammation of glands. There is no glandular organ in which traumatic inflammation has been so completely studied as in the liver; some observers finding, in the anatomical changes which result from experimental irritation, proof of the dependence of these changes on migration, while others, particularly Holm, believe that the liver-cells undergo transformation into inflammatory products, and that pus-corpuscles may be produced in hepatic mother-cells. Dr. Hüttenbrenner has recently repeated the experiments of Holm,* as well as those of Koster,† (who may be regarded as the most important expositor of Cohnheim's doctrine in its relation to inflammation of glands), and has confirmed the results obtained by both of his predecessors. He concludes that in the liver, if the irritant is such as to produce alterations which are confined to the immediate neighbourhood of the injury, the liver-cells germinate, and believes that the few pus-corpuscles which are formed under these circumstances originate endogenously. If, however, an abundant suppuration is produced, as e.g. by the injection of ammonia, it is found that the pus corpuscles are collected round the blood-vessels in a manner which certainly indicates that they are emigrants, or that the capillaries are concerned in their production. In support of the same view we may refer to the observations of Billroth* on mastitis and orchitis. In a patient who died in puerperal fever with minute abscesses disseminated throughout the mammary gland, Billroth found that the young pus-cells occupied the inter-acinar vascular network just in the same way as Koster described in the liver. Again, in an inflamed testicle taken from a patient who had died of secondary pyelitis consequent upon stricture, and had often before been treated for gonorrhœal orchitis, the connective tissue between the seminal canals was the seat of interstitial irritation, and beset with an infinite number of young cells, the glandular structures remaining themselves unaltered. In both of these cases the accumulation of leucocytes round the vessels is certainly remarkable. But before we agree to the explanation offered by Billroth we must take other considerations into account. It is to be borne in mind, that in both instances the inflammation was of a secondary, that is to say infective, character. In all inflammations of this class it appears quite as reasonable to suppose that the limitation of the morbid changes to the immediate neighbourhood of the blood-vessels is due to the fact that the infective agent is introduced into the tissue by the blood-stream, as to attribute it to emigration of leucocytes.

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* Holm, *Experimentelle Untersuchungen über die traumatische Leberentzündung. Wiener Sitzungsb.* vol. lv. part II. p. 439.

† Koster, *Entzündung und Eiterung in der Leber. Centralblatt,* 1868, p. 17.

For the present this question must remain open. All that we are justified in concluding is, that although even gland-cells under certain circumstances may be alienated from their natural secreting function, and excited into reproductive activity, this germination does not play any important part in the formation of pus.

Part III.—Influence exercised by the Form and Mode of Action of the injurious Agent on the Character of the resulting textural Changes.

Although if we be careful to distinguish what is essential to the process of inflammation, viz. the altered state of the vessels, from the phenomena which accompany it, and the textural germination which it produces, its characters will appear to us to present very slight variation, yet the visible results by which it manifests itself differ widely in different cases. It is therefore necessary, in order to complete the present subject, to consider in what degree these differences correspond to differences in the causes which produce them.

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* Billroth, loc. cit. p. 30.

Vesication.—If a hot iron is applied to the skin at a sufficient temperature, it at once destroys its vitality. If the temperature be a little below that which is necessary to produce this result, the blood contained in the vessels coagulates, and the tissue eventually dies. At a still lower temperature the skin retains its vitality, but blisters are formed at or around the injured part.

If the mesentery of a guinea-pig is touched with a heated surface, and the effect observed under the microscope, it is found that stasis is produced which is co-extensive with the surface of contact. It is tolerably certain that in like manner, in vesication of the skin by heat, the circulation of the heated part is abruptly brought to a standstill. As, outside of the area of stagnation, it goes on at first with unabated then with increased vigour, while the walls of the capillaries are probably acted upon by the heat in such a manner as to render them more permeable, we can readily understand how it happens that liquor sanguinis is exuded more rapidly and more abundantly than in ordinary inflammations. From the researches of Dr. Samuel of Königsberg it seems probable that the effects of liquid vesicants agree with those of heat in all the respects which have been referred to; so that the peculiarity of the mode of action of vesicant agents in general, would seem to lie in its suddenness and in the faculty which they possess of at once producing those changes in the capillary wall which in ordinary inflammation require a longer time and a more gradual process for their production. In this way the exudation of liquor sanguinis, instead of being deferred until the slowing of the circulation has commenced, begins immediately, and, favoured by the primary arterial afflux, and the increased intra-vascular pressure consequent on the sudden capillary obstruction, is so abundant that the liquid collects in blisters.

Relation between inflammation and the reparative process.—When the local injury is so intense as to destroy the vitality of the affected part at once, that part becomes surrounded with a zone of inflamed tissue from which it eventually separates, leaving behind it a granulating surface. To understand this process of demarcation and separation, it is in the first place to be borne in mind that the exuded liquid contains the fibrine-producing elements of the blood, and that contact with dead substance at once determines coagulation of all such fibrinogenous liquids. Accordingly, the first step in the process of reparative separation is the formation, in contact with the dead part, of a more or less solid stratum of fibrine, in which stratum the production of new capillaries and granulation-tissue commences.

What is this granulation-tissue? It consists entirely of young cells, which if they agree with leucocytes more or less in size, differ from them both in structure and arrangement. The neoplastic granulation- or embryonal-cell (as it is often termed) is a mass of protoplasm with a round or oval well-defined central nucleus. It exhibits very slight amœboid movements, and has a marked tendency to endogenous multiplication by division of its nucleus—a process which goes on with such activity that in carefully prepared sections of young granulations it may be studied in all its stages under the microscope with great facility. The arrangement of granulation-cells is determined by that of the newly formed capillary vessels around which they are grouped. At first irregular, it becomes more and more definite as the new growth is transformed into cicatrix, or into that adenoid texture which is the material of chronic inflammatory induration. It is scarcely necessary to add that the process we have been describing and that of healing by the first intention are essentially the same.

Suppuration.—Before endeavouring to explain how it is that leucocytes, after escaping from the vessels, tend to collect together in groups so as to form foci of suppuration, i.e. abscesses, I would refer to two of the vital endowments which they possess when in the active, that is amœboid state, as perhaps having an important bearing on the question; viz. the power of surrounding concrete matter with which they come into contact with their own substance, and secondly that unexplained tendency which they possess to escape from the blood-current, and to move away from it in a direction at right angles to the axis of the vessel from which they have escaped.

When a bit of fresh cellular tissue is inserted under the skin of a living animal, and allowed to remain there for several days, it becomes soaked with a liquid teeming with living amœboid leucocytes, all of which possess the ingestive faculty just referred to. It has not as yet been experimentally demonstrated that these leucocytes actually prey upon the nutritive constituents of the slough, but it certainly appears as if they determined its liquefaction.

Again, when an abscess is produced by embedding a thread steeped in an irritant liquid in some tissue, leucocytes collect in numbers around the foreign body, which soon floats loose in a collection of pus. As the cavity is considerably larger than the irritant, there must have been destruction of the natural tissue. It is surrounded by a zone of reproductive inflammation (pyogenic membrane), in which the neoplastic process already described is going on in full vigour.

In both of these instances the abundant genesis of leucocytes at and around the lesion, which gives rise to the formation of a suppurative focus, manifests itself in absorption or liquefaction of the original tissue. The two conditions stand to each other in a relation so close that we may venture to infer that the latter is a consequence of the former.

The growth of an abscess once formed is explicable on the same grounds as migration in general. Whatever cause determines the rapid filling of a bladder full of liquid inserted under the skin (p. 776), will also account for their accumulation in the cavity of an abscess, independently of any special action of its lining. With reference to this point, however, there is much probability in the supposition that the newly formed and dilated vessels of the so-called pyogenic membrane, favour by their structure and arrangement the extrusion of leucocytes.

Why one inflammation is suppurative and another not is a question we are unable to answer, excepting in so far as an answer is contained in the statement that on the whole those inflammations which are most intense and concentrated, provided that the injury done falls short of the production of instant stasis or necrosis, are most suppurative. In other words, so long as blood freely circulates, the quantity of pus produced in an injured part varies according to the intensity of the lesion.

The existence in leucocytes of a power of absorbing tissues with which they are brought into contact is probably the explanation of the destructive tendency which is so important a character of all intense inflammations.* The absorption and liquefaction of the original texture is as peculiar to and inseparable from the process of inflammation as the germinative changes which we have been describing. That it is analogous to ordinary absorption cannot as yet be stated, for we do not yet know whether the wandering leucocytes which are found in healthy connective tissues have to do with that process or not. The only other kind of liquefaction which it could be compared with is the putrefactive, but with this it has not the slightest analogy. For in no single particular, excepting that both result in disintegration, do they resemble each other. Suppurating tissues, so long as they are protected from the influence of external media, do not show the slightest tendency to septic decomposition.

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* On this subject see ADDENDUM, p. 789.

PART IV.—DIRECT INFLUENCE OF ABUNDANT SUPPLY AND FREQUENT CHANGE OF NUTRITIVE LIQUID IN STIMULATING CELL LIFE.

It is well known that if a portion of living structure is removed from its natural position and inserted or engrafted into some other part of the same or of another animal, in such a manner as to be in complete contact with living vascular tissue, the ordinary nutritive changes may go on in the engrafted fragment independently of the direct influence of the nervous system. Hence it may be inferred that if an adequate supply of normal nutritive fluid is the only condition which is necessary to determine the continuance of the ordinary nutritive changes, it is by no means improbable that the modification of this process which goes on in inflammation, may be determined in a corresponding manner by subjecting the tissue to the action of such a fluid as is discharged from congested vessels. With some such considerations as these in view, Stricker * devised an experiment consisting essentially in the insertion of a fragment of living tissue into a cavity of which the walls are in a state of active inflammation. A somewhat similar experiment had already been made by v. Recklinghausen in 1863. He introduced the cornea of a frog, immediately after excising it, into a lymph-sac of the same animal, and observed that if the cornea were left in this situation long enough for the cavity to

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* Stricker, *Ueber die Beziehungen von Gefässen und Nerven zu dem Entzündungsprocesse*, loc. cit. p. 31.

inflame and suppurate, the marginal part of it became charged with leucocytes, which, by virtue of their amœboid movement, penetrated in vast numbers into its tissue. But as v. Recklinghausen had not inserted his healthy cornea into a cavity already inflamed, and moreover had not observed the structural changes which took place, his experiment was not available for the solution of the question. The method adopted by Stricker is as follows:—He irritates one eye of a frog by cauterizing the cornea through, then excises the cornea of the opposite eye, and inserts it beneath the *membrana nictitans* of the irritated eye, finally uniting the edge of that membrane with the opposite margin of the cutis by ligatures. After twenty-four hours the transplanted cornea is removed and examined, and is found to exhibit inflammatory changes, which although they are on the whole less advanced than those found in an unexcised cornea, at the same period after irritation, are equally characteristic. In different experiments there were differences both in the degree in which the cornea-corpuscles were altered, and still more in the number of pus-corpuscles, but in all the appearances corresponded with the description which has been already given of the effects of direct irritation.

These results scarcely admit of misinterpretation; they are, however, rendered much more decisive and satisfactory by varying the conditions of experiment in such a way as to show that the changes observed are not due to the penetration of leucocytes from the liquid in which the cornea is immersed, and secondly that they are not a mere result of its transplantation into an unnatural position. The first of these objects is readily attained by dividing the cornea immediately after excision, plunging one half in water so as to kill it instantly, and then placing the dead and the living portion together, underneath the *membrana nictitans* of the opposite eye. It is then found that whereas the same inflammatory changes as before go on in the living half, the other half remains inactive. The second result is attained by the observation of what happens when, instead of first cauterizing the eye which is destined to be the recipient of the transplanted cornea, it is left uninjured. At the end of twenty-four hours the cornea-corpuscles are found quite unaltered, and so distinct that the plan is strongly recommended as a method of demonstrating their normal characters.

These varied results seem therefore to show, beyond the possibility of dispute, that the structural changes in the cornea of the frog cannot be dependent either on any influence exercised by the nervous system, or by transmission of the irritative effect from one structural element to another, so that we have good ground for concluding with Professor Stricker that they result exclusively from the stimulating influence of the exuded liquid. The precise physical or chemical conditions are as yet unknown, and are at the present moment subjects of further investigation.

CONCLUSIONS.

1. In every inflammation which attains its full development the changes which manifest themselves in the inflamed part are of three kinds, distinguished from each other according to the organs which are concerned in their production. They are either (1) effects of disorder of the vascular nerves and centre; (2) effects of alteration of the properties of the living walls of the capillaries; or (3) effects of the stimulation of the living cells by transudation of liquor sanguinis.

2. Of these three orders of phenomena the second only can be regarded as absolutely essential to the existence of inflammation, which may, therefore, in the strictest sense, be said to have its seat in and about the veins and capillaries, it being there that the earliest and most constant effects of irritation or injury manifest themselves.

3. The nervous and vascular effects of local irritation cannot be directly described as successive stages of one process; for the determination of blood to the seat of injury which is the sole result, and, if I may so speak, purpose of the vasomotor disturbance, has no relation to the local vascular changes, excepting in so far as it tends to make the exudation more abundant. Exudation of liquor sanguinis, although favoured by increased arterial afflux, may occur without it, and as a rule continues after the afflux has ceased. The vascular and textural changes, on the contrary, may be regarded as successive stages of one process, for they are connected by a causal relation—the exudation of liquor sanguinis, in which the former ends, being the determining cause of the latter.

4. The mode in which an injury changes the living substance of

the vascular walls so as to make them permeable to the blood is unknown. The nature of the change itself is also unknown, the only clue which we have to its character being that afforded by the structural alterations to which it leads in certain organs, and particularly by those which are observed when the process of reparation, attended with the formation of new capillaries, is commencing. (See pp. 757 and 778.) From these appearances we are led to infer that the primary change consists in the transition of the material from the formed to the plastic condition ; from a state in which it is resistant, because inactive, to one in which it is more living and therefore more labile.

5. In all living tissues the effect of inflammation manifests itself in a modification of the action and properties of individual cells. In cells which form part of permanent structures the protoplasm increases in quantity and becomes more or less contractile. Subsequently, it is converted entirely or partly into young cells, either by cleavage or by endogenous germination.

J. BURDON-SANDERSON.

ADDENDUM.

THE destructive effects of inflammation are traced with a master's hand in the following paragraphs, reprinted from the article on the same subject which appeared in the former edition of this work. After pointing out that both for pathology and practice it is needful that the student recognize the reality of destructive changes as an essential part of inflammation, Mr. Simon continues :—

'Let him examine inflamed muscle, as, for instance, in the post-mortem examination of a compound fracture or of a recently made stump :—He will find the structure weakened, so that it easily gives way with pressure or traction ; he will see, under the microscope, that the substance tends to fall into irregular fragments ; that its natural striation is more or less replaced, first by an almost homogeneous appearance, and afterwards by an appearance of aggregated granules ; that, with these granules of albuminous matter into which the muscle has resolved itself, there is mixed, even from an early date in the inflammation, a noticeable quantity of minute oil-drops; that often these oil-drops appear before the disintegration of muscle has made much progress, and then arrange themselves in such mutual relation, transverse or longitudinal, as to suggest that the sarcous elements have changed themselves, particle by particle, into oil; that little by little the oil-drops multiply to such an extent as to be the chief visible objects—the limitary membrane of a fasciculus seeming now to be almost filled with finely-divided oil, diffused through some scanty connective albuminous material; that the limitary membrane, within which the muscular material is thus emulsionised, tends also itself to undergo dissolution, and let its proceeds confuse themselves with the similar débris of neighbouring fasciculi, till more or less bulk of muscle is reduced to a state of oleo-albuminous liquidity.

'And from this point, if the observer have opportunity of watching the changes which lead to convalescence, he will see that gradually the liquefied material diminishes in volume; that, in proportion as it vanishes, the adjoining parts adapt themselves to the altered relation; that eventually only a scar-like puckering of substance—a kind of tendinous intersection—remains to mark the place where muscular material has irrecoverably melted away.

'Let him examine inflamed bone, as, for instance, in a carious vertebra:—He will see that the structure breaks down under his finger, and offers scarcely any resistance to a knife; that the microscopical texture is rarefied—cancelli, canals, lacunæ, being all larger than natural, and the solid framework all scantier; that the material is tending to break into its component parts, and to undergo changes which admit of its being removed by the circulation. In many cases (for example, under the irritant pressure of an aneurism) he will find that a quantity of bone has thus gone, leaving no trace behind—gone of course, only after having first become liquid; and it appears that, when bone is inflamed, the first step towards this disintegration consists in a breach of the ordinary union between the mineral and cartilaginous constituents, with a primary removal of the former, and a chemical change of the latter. If there be discharge from the inflamed part, there will be found in it bits of bone, chemically and microscopically demonstrable.

'Let him examine inflamed nerve—as, for instance, near to where it has been cut in amputation:—He will find, says Dr.

Lent, the medullary cylinder of each nerve tubule falling, as it were by cross-cuts, into irregular pieces—at first large, but as the process advances, getting smaller and rounder, and assuming the character of oil; till at last the tube-membrane is filled with oily material, which gradually undergoes removal.

‘ Let him examine the hard textures of an acutely suppurating joint:—He will find the strongest ligaments in course of being reduced to an incoherent state—either actually pulpy and half-liquefied and in course of removal, or ready to break with the least traction; he will find (unless proper splintage have been used to prevent it) that dislocation is occurring from this cause; he will find, if the inflammation have been primarily synovial, that the cartilage is smoothly melting away at its surface into the fluid which bathes it, or, if the disease have begun subarticularly, that the cartilage, where superjacent to carious bone, is irregularly eroded and perforated; and throughout, with the microscope, he will find, wherever there are evidences of advancing disintegration, that the softening material is abundantly marked with oil-drops.

‘ Let him—not in post-mortem examinations, for which there are no opportunities, but during life—observe the results of inflammation of the sclerotic, and ask himself why it is that staphyloma so often follows this disease. He will infer that here, as with other cases which we have considered, the inflammation must have so disorganised the texture, and so enfeebled its normal rigidity, that it can no longer give sufficient resistance to pressure from within, or save itself from being bulged by what now becomes an almost dropsical excess of fluid secretion within the globe.

‘ Above all, let him examine the products of inflammation furnished by mucous and serous membranes, and by glands: the expectorations of bronchitis, the hawkings of common throat-catarrh, the urine of scarlatina, the acute effusion of serous cavities, and, after death, the inflamed organs themselves. Let him once thoroughly recognise the destructive acts of inflammation, as illustrated in the simple cells of gland or epitheliated membrane; and the whole of this argument will be compendiously before him. He will find cells (especially where they are squamous) shed as dead material, without their first undergoing any appreciable alteration. He will find all others undergoing change in a more or less marked degree—change, of which the essence consists in a loosening and eventually a disintegration of texture, with increased imbibability by fluid, and gradual accumulation of oil; so that the cell, while undissolved, appears of larger than natural size, its wall less defined, its nucleus dimmer, its contents more granular and oily than in health. Sometimes a cell is thus converted into a mere heap of oil-drops held together by little intervening or surrounding material; sometimes there will be more albuminous matter, perhaps in a granulated or dotty form; sometimes there will be more evident fludity of contents; but in any case the cell, if retained within the body, tends to break up and contribute with its neighbours to the making of an oleo-albuminous fluid, in which there exist but scanty and evanescent remains of the original cell structure.'

APPENDIX.

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SURGICAL DISEASES OF CHILDHOOD.

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THE surgery of the diseases of childhood naturally divides itself into three different classes, viz. the pathology and treatment of, 1. Malformations; 2. Injuries and their sequelæ; 3. Diseases. The purport of this essay is not to give a complete account of each of these subjects, inasmuch as many of their topics have been treated elsewhere; but to indicate the matters with which the surgery of childhood is principally concerned; to point out to the reader whereabouts in this work such of those matters as have been included in previous essays may be found; and to give a short account of those which have not been elsewhere treated.*

It is a very well-known fact that children will sometimes bear severe accidents or surgical operations without any injury to their general health; while at other times much slighter injuries or operations are followed by very alarming symptoms, and sometimes even by death, although the child does not seem unhealthy, and is not much reduced by disease; so that children are sometimes said to bear operations better than adults, and sometimes the reverse. It is not always easy to explain this discrepancy; but the main principle to be borne in mind in operations on children seems to be this—that children bear the loss of blood, and all other causes of sudden shock, worse than adults; but bear protracted suppuration and long confinement to bed better, and are far less liable to the secondary complications of wounds. Erysipelas in its milder form is not very rare in children's hospitals, where the spreading or ulcerative variety of phagedæna may also be occasionally seen; and the condition usually known as diffuse phlebitis is also met with, though more rarely; but pyæmia, though not unknown, is exceedingly rare; and diffuse cellular inflammation (or phlegmonous erysipelas) is almost, if not quite, unknown.

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* The following list comprises most of the topics in the foregoing pages which relate exclusively to diseases peculiar to, or more usually met with, in childhood: Noma, or cancrum oris, vol. i. p. 159; Trismus nascentium, p. 313; Scrofula, p. 351 et sqq.; Congenital cutaneous cysts, p. 514; Vascular tumours, p. 541; Burns and scalds, vol. ii. p. 1. et sqq.; Separation of epiphyses, p. 39; Incomplete fractures, p. 41; Depressions of the skull, p. 268; Foreign bodies in the ear and nose, pp. 421–423; Burn and scald of the larynx, pp. 465–467; Foreign bodies in the air-passages, p. 472 et sqq.; Laryngotomy and tracheotomy, p. 497; Rupture of the thoracic viscera, without wound, p. 615; Rupture of the urethra, p. 726; Dislocation of the head of the radius, p. 831; Supernumerary auricles, vol. iii. p. 258; Strumous glands, p. 340; Orthopædic surgery, p. 658 et sqq.; Diffuse periostitis, p. 740; Scrofulous disease of bone, p. 778; Scrofulous disease of joints, vol. iv. pp. 16, 42; Hip-joint disease, p. 79; Spinal disease, p. 102; Tongue-tie, p. 215; Gumboil, p. 325; Congenital hypertrophy of gums, p. 342; Exanthematous jaw-necrosis, p. 383; Diphtheria and croup, p. 496 et sqq.; Enlarged tonsils, p. 404; Cleft palate, p. 414; Nævus of lips and cheeks, p. 443; Congenital cysts of the mouth, p. 451; Congenital malformation of intestines, p. 603; Intussusception, p. 612; Congenital hernia, p. 654 et sqq.; Prolapsus of rectum, p. 814; Polypus of rectum, p. 858; Extroversion of bladder, p. 881; Incontinence of urine in children, p. 909; Hypospadias and epispadias, p. 939; Stone, p. 1002 et sqq.; Congenital malformations of vagina, vol. v. p. 3; Imperfect development and retention of testis, p. 72 et sqq.; Congenital hydrocele, p. 84; Means of strangulation of nævi, p. 553; Harelip, p. 571; Contracted cicatrices, p. 586. Besides these, all affections of the eye, the ear, the skin and its appendages, and the various excisions, will be found in the essays devoted to those subjects.

Our first care in operations on children must be to avoid shock. Hæmorrhage is the chief cause of shock, where anæsthetics are used; but when this is not the case, pain, terror, and struggling are also most efficient causes of prostration, and more especially in protracted operations. Even when chloroform is used, a very protracted operation is liable to be followed by prostration—both because long operations generally involve the loss of much blood, and because the prolonged administration of chloroform is itself a very serious cause of depression. I have had no experience of the effect of ether when administered for a long time; but there seems every reason to believe that it would prove equally depressing. But operations in children are often made longer by the necessity which there is for examining the parts under chloroform at the time of the operation, since the child will not permit this to be done without the anæsthetic. In all cases, however, in which it is possible, this examination should be performed a few days previously; and the surgeon should come prepared to begin the operation at once. If the proceeding is of such a nature that the child must necessarily be kept for a long while under the influence of the anæsthetic, it seems a good plan to administer a stimulant a little while before, such as a glass of wine or a little sal-volatile.

But even without much bleeding or prolonged suffering, there are some cases of operations in children in which the shock proves fatal without any obvious cause. This is no more than what happens sometimes to very sensitive adults; but it is, perhaps, more frequent in children. Thus, in a case of lithotomy under my care, the bladder was reached without difficulty or hæmorrhage; only a slight delay occurred in seizing the stone, on account of its smallness and smoothness; the child was on the table altogether only a few minutes. No bleeding occurred afterwards, except the slight oozing which frequently follows the flow of urine over the surface of the wound. Still, the boy never rallied, and died next day. There was no lesion discoverable on post-mortem examination. Stimulants were given in this case; but perhaps not so freely or so frequently as they should have been. If such a case were to occur again, it would be well to make the child take small quantities of wine and of diffusible stimulants every hour, until a decided change for the better resulted. Of the serious effects which may follow upon the shock, pain, and struggling of an operation, even when there is no hæmorrhage, the following example occurred to me. A twin child, a few weeks old, was brought to me for advice as to a congenital tumour of the orbit, which had pushed out and ruptured the globe of the eye. In consequence of the rapid growth of the swelling, life could not be long maintained unless the disease were removed; yet the child was so exceedingly puny, emaciated, and feeble, that it was obvious the least injury might prove fatal, much more so serious a proceeding as removing a tumour which filled the whole orbit, and projected a good deal on to the face. Having placed the risks of the operation fairly before the mother, I proceeded to remove the tumour without administering chloroform. Perhaps this was not the best course which could have been pursued. Very possibly the careful administration of a small quantity of the anæsthetic, sufficient to dull the sense of pain without producing more profound anæsthesia, might have saved the child from the consequences which did ensue. The operation was finished without much blood having been lost; but then the child passed into an alarming state of syncope. Restoratives were at hand; and when by stimulation with ammonia, wet sponges dashed on to the face and throat, and artificial respiration, the powers of swallowing had been regained, a little wine and brandy could be given, and the child seemed restored to life. But she soon relapsed, and appeared again to be dead; in fact, was pronounced dead by some of those who were standing about. Artificial respiration revived her for the time; then the galvanic battery was brought into play, and applied to the chest with marked benefit; stimulants being also constantly administered. But for three-quarters of an hour the child's life was in the most extreme danger; and as soon as the galvanism was suspended, syncope recurred. At the end of that period, she recovered permanently from this alarming condition.

This mention of the grave symptoms which may follow upon the pain and shock of an operation naturally introduces the consideration of the administration of anæsthetics in childhood. No department of surgery has profited more by the discovery of anæsthetics than that which is concerned with children's diseases. It is very frequently quite impossible to examine a diseased joint satisfactorily and thoroughly, to sound for stone, or to perform any other examination which either lasts long and produces pain, or which requires quiet and silence, without rendering the child unconscious. Hence the administration of ether and chloroform is of daily occurrence in our children's hospitals; and the very great rarity of accidents from such administration shows that in all essential particulars chloroform (which is the anæsthetic usually employed) is as safe as it is certainly efficient. But chloroform often causes unpleasant, and sometimes even alarming, symptoms; and although I have not yet had the misfortune to witness a fatal result, I saw one case in which the patient was only revived by a vigorous application of restorative measures from a condition of apparent death. The unpleasant symptoms referred to are chiefly the rapid fluctuations of pulse, and the tendency to sudden congestion and stertor. If these threatening symptoms be overlooked, and chloroform still given, the pulse and respiration may be suddenly suspended, and alarming or even fatal symptoms ensue. So that it is always necessary to watch the pulse closely, and to give chloroform with great caution in children, even when they breathe it quietly; and still more when, from their struggling and crying, the anæsthetic is taken in irregular and often very full doses. Usually after such struggles the child passes almost at once into an insensible condition; and, as soon as this occurs, the chloroform should be administered only to such an extent as to prevent struggling. Both children and grown people when under chloroform will give indications of pain, while the real feeling of pain (at least if tested by the patient's remembrance of the operation) is quite absent. It is therefore not necessary for the comfort of the patient that every movement and every sound indicative of pain should be suppressed.

When asphyxia comes on, prompt measures will almost always save the patient. The tongue should be at once pulled as far as possible out of the mouth with a pair of forceps, and artificial respiration should be resorted to. Whatever difference of opinion may exist as to the most effectual method of performing artificial respiration in other cases, I should think that a very little experience would convince anyone that in those at least of asphyxia from chloroform in childhood, the most natural and simple method is also the best, viz. by manipulation of the ribs. The small size and yielding material of the chest-walls in childhood enable us to manipulate the lungs through them almost as easily as if they were uncovered. Dr. Marshall Hall's method (if it is ever more effectual than manipulation) is certainly inapplicable in these cases, since it endangers the flow of substances from the stomach into the larynx, and interferes with other restorative measures which may do good, but which cannot be allowed to supersede artificial respiration.

It does not appear that there are any limitations to the use of anæsthetics in childhood. I have administered them at the earliest periods of life, and believe that, with proper care, operations are safer with them than without them, even in the most exhausted and puny infants. In harelip and other operations about the mouth which do not last a long time I rarely administer chloroform, although I have no strong objection to doing so; but in all other painful proceedings the general rule should be to give it. One motive, however, for the use of anæsthetics is absent in children, since they have little apprehension of the operation, and thus do not suffer from those agonies of anticipation which are often the worst part of a surgical operation to an adult.

As soon as the child has recovered consciousness, the smarting of the wound, and the remembrance of his fright, make him cry violently; and then, unless vomiting seems probable, it is well to give a few drops of laudanum, proportioning the dose to the child's age. But in other cases the operation is succeeded by a quiet sleep. Vomiting, which is very common with children, even if they have had no food for some time, usually subsides before consciousness is completely restored, and is very seldom troublesome.

Serious operations in children are almost always followed by smart fever. This is, however, usually transitory, and subsides with the commencement of suppuration, and it may be much diminished by irrigating the wound with water dropped out of a bottle by means of a lamp-wick, or the application of ice, as recommended by Professor Esmarch. The greater probability of union by first intention in children makes it justifiable to close wounds which would be left to granulate in the case of an adult patient; but any dressing which is likely to prove painful, whether in application, in use, or in removal, ought to be avoided as much as possible.

MALFORMATIONS.

TABLE OF MALFORMATIONS.

I. Of the whole body, or general. Double monsters; attached fœtal remains.
II. Of the head and face. 1. Of the mouth: congenital fissure; harelip; fissured palate.[*]
congenital closure or atresia oris; microstoma congenitum.
2. Of the nose: congenital absence.
„ fissure.
3. Of the eye:[†] „ defects of iris.
„ cataract.
„ closure of the lids.
4. Of the head:[‡] cephalæmatoma, congenital tumours; meningo- and encephalo-cele.
Of the spine. Spina bifida; congenital tumours.
III. Of the neck. Congenital closure of œsophagus; congenital stricture.[§]
IV. Of the thorax. „ fissure of the bones; malformation of heart.[§]
V. Of the abdomen, &c. Congenital defect of parietes;[§] malformation of viscera;[§] imperforate rectum; congenital hernia;[||] undescended and retained testis.[¶]
Congenital adhesion and imperforation of vagina.[**]
Hypo- and epi-spadias; extroversion of the bladder.[††]
Hermaphroditism. Congenital defects of the pelvis.[§]
Imperforation of the urethra.
VI. Of the limbs. Deficiency of bones and limbs;[§] supernumerary fingers and toes; webbed fingers and toes; congenital dislocations; fracture and amputation in utero.

Attached Fœtus.

In very rare instances twins become attached in the womb, and are born thus into the world; and this in two different conditions, viz. either as two living individuals united at some part of their bodies; or one fœtus is only imperfectly developed, and in this imperfect condition is attached to the other as a parasite.

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[*] Treated of above, see vol. iv. p. 414, vol. v. p. 572.

[†] Treated of in the essay on DISEASES OF THE EYE, vol. iii.

[‡] Treated of in the essay on REGIONAL SURGERY.

[§] Nothing is said about these malformations here, since they do not admit of surgical treatment.

[||] See the essay on HERNIA.

[¶] See the essay on DISEASES OF THE MALE ORGANS.

[**] See the essay on DISEASES OF WOMEN.

[††] See the essay on DISEASES OF THE URINARY ORGANS.

Of the first condition the Siamese twins and the Hungarian sisters are the best-known examples. The only purely surgical question which occurs with reference to the treatment of such cases of monstrosity is as to the expediency of dividing the connecting ligament, and setting them free from what is not merely a restraint but also a grave danger, since the death of one twin must necessarily involve that of the other. In a work like the present it would be absurd to waste space upon such curiosities of surgical practice, in the treatment of which the surgeon would be bound to have recourse to the authorities specially devoted to the subject.* It may, however, be stated in general terms that when important parts (such as the anus) are common to the twins, the operation is impossible; that when the connection is in or near the buttock, a communication may fairly be supposed to exist between the spinal columns, which would render any operation fatal; but that when the connection is sideways, and the band of moderate thickness and extent, the operation ought to be attempted, and has been performed with success;† also that if one twin die before the other, an attempt might be made to cut the dead one away.

The second class of joined twins—viz. that in which one of the twins is only slightly developed, and included in the living twin as a parasitic growth—is of considerably more importance in surgery than the former, since both the diagnosis and the treatment become occasionally matters of considerable doubt and difficulty. I shall consider these cases under the natural division of attached parasites and included parasites; but we must not forget that this division, however natural, is not to be trusted in practice, since a great part of the attached parasite may be included. However, the difference is so striking between those cases in which large parts of the parasitic fœtus (usually terminating in more or less rudimentary extremities) hang pendulous from the principal organism, and those in which the parasitic remains form a mere tumour which may not even be prominent under the skin, that the distinction will always be made.

No difficulty of diagnosis can exist in the case of the attached parasite. The advantages and the feasibility of removing it from the body to which it is appended will depend in a great measure upon the place and extent of its attachment, and partly upon the nature of the parasite itself. If a large part of the imperfect twin is attached in the near neighbourhood of vital organs, as in the case of the Asiatic, whose cast is in so many museums, having a large part of the body and both extremities of another fœtus hanging from his thorax, much care would be required in attempting the removal of the parasitic growth. Still there would, I should suppose, be no insuperable difficulty in amputating at any rate so much of it as would restore the person to a natural appearance when clothed. A clamp might be fixed tightly on the neck of the tumour, or large vessels might be discovered and tied before the operation, or the pedicle might be severed by gradual strokes of the knife and the vessels tied as they were divided, or finally the question of piecemeal amputation at several sittings might be entertained.*

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* Amongst which may be specially mentioned Dr. W. Braune's work entitled *Die Doppelbildungen und angebornen Geschwülste der Kreuzbeingegend*, where all the cases of twins attached in the sacral region are given.

† The case in which adhering twins were successfully separated is related by König in the *Ephem. Germanicæ* (nat. cur.), 1690, vol. viii. dec. ii. obs. 145.

A drawing is given of them united by a band, which is described as stretching from the ensiform cartilage to the umbilicus, and as being an inch broad, one and a half inches deep, and five inches long. The umbilical cord was single, and contained four arteries and two veins. Its lower part was attached to the band, and it seems doubtful whether the band was really anything more than a fusion of the two cords. A ligature was put upon it first, and then it was divided with a knife. The separation, he says, was effected 'ligaturâ prægressâ indies strictiori, dein cultelli scissurâ.' Mr. Startin proposed a similar plan for the separation of the Siamese twins, by surrounding the connecting band with a metallic girdle, formed of two parts sliding on each other, and hooped together by pegs or notches. One of these notches being drawn in every day the girdle would be imperceptibly tightened, till merely a thin band of skin would remain, which could be severed without any risk (*Brit. Med. Journal*, Feb. 20, 1869.)

The removal of such parasites when they occupy (as they far more often do) the pelvic region is very necessary to the patient's comfort; but here, before their removal is decided on, the question of their nature and connections must be very carefully considered. In those cases of double monsters (like the Hungarian sisters) where the twins are attached by a broad band near the buttocks, it has always been found that either the rectum, genitals, or lower end of the spinal column, or all these parts, were common to both bodies; and therefore that the twins could not be separated without fatal consequences. But when the deformity is that which is commonly called 'the human tripod,' in which the two legs of another fœtus, blended together into one, are attached to the pelvis, no such connection is probable. The genitals of the parasitic fœtus as well as the spinal column are probably absent; and if they were developed, it would still be possible in many cases to remove the projecting extremities. In cases of tripodism, therefore, amputation should be practised, especially on males, in whom the defect could only be concealed from view by condemning them to wear female clothing. All the published cases of this deformity will be found collected in the work of Braune, *Die Doppelbildungen*, &c. I would especially call attention to the case (mentioned in that work on p. 20) of Anna M. Przesomyl, a Bohemian. She was shown, at six years of age, to the Gesellsch. d. Naturforscher in Prague, and had then an irregular oval swelling, covered by the normal skin, hanging from the buttock by a pedicle, so that it struck against the legs when she walked. The skin was healthy, except over the pedicle, where it was thin, and almost like mucous membrane. Bodies resembling long bones could be felt in the tumour, and there were 'evident traces' of fingers or toes projecting from its lower part. Fœtus in fœtu was universally diagnosed. As no evidence could be obtained of the extent of the tumour inside, or of the nature of the connection with the pelvic organs or spine, the operation was declined. The child was then taken about as a show, and seen by all the anatomists and surgeons of Germany, Holland, Sweden, and Denmark. Dieffenbach wanted to remove the parasitic growth; but the father would not consent on account of the gain which he made by showing the child. The parasite grew; but her health continued quite good. At sixteen she determined to have it removed (although she could walk quite upright, and had perfect health), so much did she suffer from the weight of the parasite. Its shape, size, &c. are shown in an engraving in Braune's work. The length was about 26 inches; the weight was guessed at about 20 pounds; the pedicle, which passed into a kind of niche in the buttock, was about as thick as the forearm.† It was successfully amputated through its first swollen portion, leaving a considerable stump; but this stump, which would never heal, was accidentally attacked with gangrene

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[*] Since the above was written, I have been informed by Dr. Pancoast, jun., of Philadelphia, of a case in which his father has successfully removed with the écraseur an attached parasite from the facial region. The photographs of the child before and after operation are in the Museum of St. Bartholomew's Hospital. This operation seems to have been done in early infancy; and it would probably be in most cases advisable to make the attempt as soon as possible. More than ordinary complications in the operation, or unusual weakness of the infant, might induce the surgeon to wait for a time. The photographs referred to show that the parasitic fœtus was attached to one cheek of the living child, that the body was provided with rudimentary extremities, and ended in a large fibro-fatty mass; and that on cutting it open many of the parts of the natural body could be distinctly traced in it, especially the gastro-intestinal tract. The only harm that was occasioned by its removal appears to have been that a fistula into the mouth of the infant was left in consequence of the buccinator muscle having been prolonged into the coverings of the parasitic fœtus, and having been injured in its removal. It is very much to be wished that further particulars of this remarkable case should be published.

[†] *Prag. Vierteljahrsschrift*, 1850, vol. xxv. p. 74.

in consequence of a fall, and was then successfully removed by ligature and sawing through its bony connections. In the end the girl seems to have been quite cured.*

I need not dwell here on the cases of included parasites (i.e. fœtal remains forming a tumour, either subcutaneous or in one of the great cavities or viscera), since such cases must be treated on the same rules as any other innocent tumour. It is, in fact, only when the parasite is near the surface, and lies in a situation in which such growths are often met with, as the sacral or coccygeal region, that the nature of the affection can be even suspected before operation. The general rule of surgery must be borne in mind, that when a tumour threatens life, it is justifiable to run any risk for its removal; but that in operations of complaisance, as those are termed which are performed on account of affections not incompatible with bodily health, no danger ought to be incurred, except at the express wish of the patient, or his friends, if a child, after the nature of the case has been properly explained.

Congenital sacral tumours.—In connection with these cases of included fœtus and attached fœtus we must also speak of those rare cases in which congenital tumours are found in the sacral region, which have no distinct marks of parasitic origin. Such are the cystic, fibroid, and fatty congenital tumours.

These tumours it is important on many grounds to distinguish from the included and attached parasites. They are divided by Braune into three categories: 1. coccygeal tumours, which are compound cystic, and other congenital and more or less solid tumours of this region; 2. simple cysts; 3. caudal excrescences and lipomata. The first class are of various composition, and grow more or less rapidly. They are intimately connected to the sacrum and to the coccyx, when that bone is developed; and they very frequently are in connection with the spinal membranes. When the spinal canal, however, is closed, they usually spring from the interior of the pelvis, and press the coccyx backwards. The anus is displaced forwards, and the growth is, according to Braune, always limited by the edge of the gluteus maximus muscle. Operative interference with such tumours is in the highest degree dangerous, and should by all means be avoided if possible,† though the occurrence of convulsions or other symptoms dangerous to life may induce the surgeon in rare instances to interfere. Such was the case in the only tumour of this kind which I have myself seen. It was in appearance a simple fatty tumour, but was connected with the interior of the spinal canal, and had caused convulsions. It was extirpated with success by Mr. Athol Johnstone, whom I assisted in the operation. We both saw distinctly the bulging and pulsation of the spinal membranes after the removal of the tumour. The child died of another disease some months afterwards; and the nature of the tumour was proved by dissection.‡

The other descriptions of congenital sacral tumour, viz. the cystic and the caudal or lipomatous, are apparently somewhat less dangerous, especially the former, although none of these tumours can be operated on without risk.

The main points in the consideration of these rare affections are to distinguish if possible between the congenital tumour and the parasite, and to determine in the case of either of them whether there is any connection with the interior of the spinal canal or with the pelvic viscera. The distinction between the parasites which do not show characteristic shapes (as those do, for instance, which terminate in fingers and toes) and the tumours is by no means easy. Even after removal from the body, it is not always possible to be confident as to those which contain a number of cysts mixed with various tissues, such as shapeless masses of cartilage and bone, whether these tissues are parts of an undeveloped fœtus or mere accidental formations.*

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* Other instances of the successful removal of these superfluous limbs will be found in my work on the *Surgical Treatment of Children's Diseases*, 2nd edition, pp. 11, 12.

† Braune gives reference to 46 cases, in 16 of which operative measures were attempted; but in only 5 with success. In all 5 extirpation was the method adopted, which is much preferable to ligature or puncture. The subdivisions which Dr. Braune makes of this class of tumours are not necessary for our purpose.

‡ *Path. Soc. Trans.* vol. viii. pp. 16–28.

I published a short time since the account of a very large congenital tumour, of the compound cystic variety, projecting in the left buttock, and attached near the coccyx, which I removed successfully from a female child, three years of age. The tumour was so intimately connected with the lower bowel that it had an impulse on coughing just like a hernia. The contents of the large cyst were fluid, resembling cream in colour, but very fetid. At its base were some smaller cysts, but no distinct traces of any fœtal structure.† A somewhat similar case, under the care of M. Stoltz of Strasbourg, appears to have been of the dermoid variety.‡ Numerous other instances of the successful extirpation of these congenital sacral tumours have been put on record.

In congenital sacral tumour, whether from fœtal inclusion or not, the question of surgical interference depends not on the origin but on the connections of the tumour; that is to say, that there are fœtal tumours which may be removed with perfect success, while there may be other tumours, not fœtal, in which the formation may be so far within the pelvis as to be inaccessible to the knife. Another point is, I think, equally clear from the records of the treatment of such cases, viz. that the total removal of the tumour is a safer course, if surgical interference is admissible at all, than any partial operation.

Thus in a well-known case under his care, Sir B. Brodie says: 'Contrary to my advice, a surgeon made an incision into the tumour, which not only served no useful purpose, but left him in a worse state than he was before. Different cysts suppurated, discharging pus and adhesive fluid; sometimes a collection of fluid and pus pressed on the rectum, occasioning a difficulty of expulsion of fæces, and then discharging its contents into the bowel. After this he was always in a state of greater or less suffering. He lost flesh, had occasional attacks of fever, and at last he sank and died.'—*Path. Soc. Trans.* vol. iii. p. 447.

In fact, it is difficult to see what useful purpose is to be served by these partial proceedings. Either the tumour is within reach of dissection, or it is not. If it be, and if the operation be undertaken in childhood, and the operator succeed in removing the tumour entire, there is hardly an instance on record in which the operation failed of success in uncomplicated cases. But suppose, on the other hand, that the tumour passes so deeply into the pelvis as to be beyond the reach of the knife; what prospect is there then that even a child, far less an adult, could survive the diffuse cellular inflammation, the consequent abscess in contact with the pelvic peritoneum, and the possible visceral complications which would follow from laying open such a cyst with a view to its obliteration by granulations, or from passing a seton through it, or from injecting it with an irritating fluid? I think it undeniable that in any doubtful case the more prudent course would be to endeavour to remove the tumour; and if this turns out to be impossible, then as a *pis-aller* to remove as much of it as possible, and leave the remaining cavity to granulate up I speak of it as a cavity because these tumours are generally more or less cystic: and I should suppose that the prolongation of a solid tumour deep into the body could be ascertained before operation.

The question, then, resolves itself into discovering the connections of the tumour as far as possible—whether it communicates with the spinal canal, with the rectum or bladder, or passes up so far into the pelvis as to be inaccessible. The diagnosis must be allowed to be sometimes very difficult. If the tumour, as in my case, be situated quite to one side of the middle line, the idea of its spinal origin may be laid aside; but in all doubtful cases the nature of the fluid contained in the sac should be very carefully ascertained by puncture and subsequent chemical observation. The communication with the spinal canal is often so small as to escape detection by physical examination; so that if a tumour lying in or near the middle line contains fluid resembling that of spina bifida, it must be regarded as of spinal origin; and no attempt should be made to extirpate it.

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* This remark is illustrated by a preparation in St. George's Hospital Museum, consisting of a number of irregular pieces of bone from a congenital tumour removed by Sir B. Brodie from the sacral region. The operation proved fatal.

† *Surgical Treatment of Children's Diseases*, p. 14.

‡ See the French translation of the above work by Dr. Larcher, p. 17.

The communication of a tumour of this kind with the rectum can be judged of by the occasional discharge of its contents in the motions. Whether this fact precludes the possibility of successful removal, is a question for the surgeon carefully to weigh. It is, to say the least, an obstacle to operation. Communication with the other pelvic viscera, as the bladder or vagina, is no doubt possible; but I do not know of an instance.

The depth to which the tumour extends in the pelvis can only be imperfectly determined before operation. On the one hand, my case shows that even a very distinct impulse may be present without the tumour being in contact with the abdominal portion of the intestines, or penetrating into the general peritoneal cavity; while a case reported by Senftleben * on the other, proves that the peritoneum may be opened in operating on a case where no such impulse has been noted, though it proves at the same time that such an accident is not necessarily fatal.

In the *Brit. Med. Journ.*, March 23, 1867, I have collected the results of all the cases of congenital sacral tumour, which are reported by Braune, where operations were practised, with the addition of Corradi's,† Senftleben's, and Jollye's ‡ cases, which were published since the date of Braune's work, and all of which were successful.

The following are the main results: 1. As to congenital tumours not of a fœtal nature, including all forms of tumour, both solid and cystic, extirpation was carried out in nineteen cases reported by Braune, though in some of them it seems not to have been complete.

Four of these tumours communicated with the spinal canal. In the two cases where the surgeon was able to remove the whole tumour, the operation succeeded; the tumour being in both cases fatty. In the two other cases the tumour (more or less cystic) was only partially removed, and death followed.

In five cases, where the tumour was pendulous and more or less solid ('caudal lipomata,' Braune), extirpation was complete, and successful in all.

This leaves ten cases of tumours, chiefly cystic, unconnected with the spinal canal, and attached to the sacrum or coccyx. Extirpation was only partial in two cases; in one of which the result was fatal, in the other doubtful. In the other eight cases the removal seems to have been complete, and all the patients recovered except one. To these Mr. Jollye's case is to be added.

The other methods of treatment, less radical and in appearance less formidable, show nevertheless a result in striking contrast to the great success of removal. Under the head of simple 'incision,' or 'puncture,' are contained the records of four cases of 'coccygeal tumour,' and five of 'sacral hygromata.' All were fatal. But in another case of sacral hygroma, puncture followed by iodine injection was effectual in curing the disease. The ligature was used in three cases of 'coccygeal tumour,' and in two cases of sacral hygroma; the two latter cases were cured, the three former were all fatal; but it is fair to note that in two of them it seems as if the complete extirpation of the tumour was contemplated, but was found impossible, owing to its extensive connections, the disease being of a malignant nature. Here the ligature seems to have been employed only as a last resource, probably to save the patient from bleeding to death.

The inference from this is inevitable, that in all those cases of congenital sacral or coccygeal tumour in which it appears desirable to interfere at all, the complete removal of the tumour, either by the knife or the ligature, should be the aim of the surgeon, and that it is in reality far more safe to dissect-out the tumour than to pass a ligature beneath it. In a case where the tumour spreads so far into the pelvis that it cannot be followed with the knife, the ligature perhaps must be used, but it can hardly succeed in curing or even checking the progress of the disease. Punctures (except for purposes of exploration), incisions, and setons, ought to be absolutely rejected; nor would I advocate the employment of iodine injection in any case that seemed at all suitable for removal.

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* *Deutsche Klinik*, 1865, p. 174.

† *Ann. univer. di Med.* for 1866, vol. cxcv. p. 423.

‡ *Lancet*, Aug. 4, 1866.

Next with reference to tumours of fœtal origin. After laying down the natural division of these fœtal tumours into 'supernumerary limbs' and 'parasite-tumours,' and calling attention to the insufficiency of minor operations, Dr. Braune says: 'Either amputation or extirpation, whether with the knife, ligature, or écraseur, must always be the operation undertaken. In case of supernumerary limbs, flaps are formed, and the proceeding more resembles an amputation, while in the parasite-tumours it is more of the character of extirpation. Where the tumour is pedunculated, pendulous, or with a bony attachment and very vascular, the écraseur may be used with advantage, or Middeldorpf's galvano-caustic, which more than replaces the old ligature and annular application of the cautery.

'Incision into the fluctuating swelling was practised twice, and was followed in both cases by death. In one, injury of the spinal membranes was the cause, the tumour being of the nature of spina bifida.

'The bony stalk was sawn through, and its upper part left in the pelvis in three cases, and in all with success.

'Extirpation was practised eleven times, ten times with success, in the other with a fatal result, spina bifida being also present.

'The ligature was used three times, twice successfully, once it had to be taken off again on account of convulsions.'

The three amputations referred to above were—1. By Pitha, quoted above, p. vi. 2. By Geller (*Virchow's Arch.* vi. 520), of a tumour terminating in a finger and of very large size, which was removed at the age of eight weeks. 3. By Schuh (*Wien. Med. Wochensch.* 1855, No. 51), of a large tumour containing portions of intestine, nerves, and numerous pieces of bone, and attached to the sacrum by a bony pedicle.

To these instances of amputation of supernumerary limbs I may add Dr. Corradi's case, in the *Annali Universali* for 1866.

The successful cases of extirpation of a sacral tumour with fœtal remains belong to the following surgeons: Jacob of Dublin, Otto, Middeldorpf, T. Blizard, Schwartz, Laugier, Porta, Lotzbeck, Emmerich, and Osiander. For the references, I must refer to Dr. Braune's work.

To these instances of successful extirpation, Senftleben's case, above quoted, is to be added; making the number of successful operations eleven, against one failure.

The total result of this series of operations would be, that we have two instances of successful amputation of well-marked and large-sized supernumerary limbs, two of amputation of tumours of fœtal character and attached to the pelvis by a stalk, and twelve of extirpation of tumours of a fœtal nature apparently not so attached, and that in all the cases, except one of the last-named, the operation succeeded; while in the fatal case the disease was complicated with spina bifida.

I think, then, that the evidence which I have here produced (and which includes, though perhaps not the whole, certainly the great bulk of the published cases) is very favourable to operative interference in these distressing deformities. The results of experience also confirm the conclusions of *à priori* reasoning, in showing that when operative measures are necessary, total removal is the proceeding that should be adopted. In the great majority of cases I think that the knife will be found safer than the écraseur, and *à fortiori* than the ligature.

It appears more prudent, both in cases of subcutaneous parasitic formations and in compound tumours, not to be too anxious to extirpate the entire growth.

If the projecting portion which is interfering with the patient's comfort be removed, that is all that may be necessary. A too-deep dissection may easily produce fatal mischief. It does not seem that supernumerary limbs, if amputated, ever grow from their base; and in the case of tumours, though they may certainly grow again, the risk of having to perform a second operation seems to be, on the whole, the less evil of the two. The simple cyst must, however, of course be extirpated entire, if at all.

Congenital malformations of the face are not limited to harelip and fissured palate exclusively, although those malformations form so much the larger part of the whole, that a man may have had an extensive experience in the treatment of them without ever having had an opportunity of seeing the rarer forms.

A condition of the mouth is spoken of similar to that which so often affects the anus, viz. congenital imperforation—atresia oris. It does not seem, however, that any instance is related as having occurred within modern times. The treatment would consist in removing the membrane which closed the mouth, and attempting to unite the skin to the mucous membrane around the opening, so as to promote union by the first intention, without which a recurrence of contraction would be to be feared.

The congenital smallness of the mouth (microstoma congenitum) spoken of by Von Ammon and Dieffenbach * appears to be merely a phenomenon of deficiency in the development of the lower jaw, and therefore to be beyond treatment.

A fissure similar to the common harelip is said † to have been occasionally noticed in the lower lip; and another similar deformity is that which extends laterally from the angle of the mouth, so as to expose the back teeth.‡

Fissures into the nostril through the substance of the cheek are also met with in a few instances.

All such deformities must be treated on the same general principles of plastic surgery which guide us in operations for harelip; viz. to close the opening by drawing over it the soft parts with their raw edges in as neat apposition as possible, and with as little tension as may be. Any adhesions to the bones of the face which render this difficult must be divided. If the cleft be very large, it may be necessary to cut free a flap to glide over and fill it; and in all cases in which the muscles tend to drag on the wound, their action should be neutralised by the 'harelip suture.'

Congenital absence of the nose has been spoken of, the feature being replaced by two mere openings on the surface of the face; and an operation has been described, which is said to have cured this horrible deformity.§ It is not, however, very clearly described, nor does the case seem to have been satisfactorily followed up. It is difficult to understand how a prominent feature could be fashioned out of the soft parts, if the nasal bones were wholly absent. In such a case Langenbeck's operation for transplanting the periosteum of the frontal bone might possibly be of service.

The congenital defects of the organs of vision have been spoken of in vol. iii.

The malformations of the brain and its coverings, which give rise to the tumours of the skull named meningocele, and encephalocele, will be found described with the other tumours of the same region in the essay on REGIONAL SURGERY.

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* Fritze u. Reich, *Plastische Chir.* p. 90.

† Nélaton, *Path. chir.* vol. ii. p. 699.

‡ Von Ammon, *Angeborne Chir. Krankht* tab. iv. p. 14; Debout, *Bull. de Thér.* vol. lxiii. p. 15. Sir W. Fergusson, in his lectures at the Royal College of Surgeons, exhibited drawings of each of these malformations (*Lancet*, June 25, 1864); and drawings of all these malformations of the face have been inserted by Dr. Larcher in his translation of my work on the *Surgical Treatment of Children's Diseases.* (See above fig. 360, p. 581.)

§ Maisonneuve, in *Bull. de Thér.* 1855, vol. xlix. p. 559.

The next congenital affection which should engage our attention is *spina bifida.* This is a malformation which is seen, perhaps, more frequently than any other except harelip. It may be defined as a congenital hernia of the spinal membranes through a fissure in the walls of the canal. Thus a tumour is formed, which is usually of a rounded shape, lying in the middle line of the back, fluctuating, often semi-transparent, adhering to the bones of the column either directly or by means of a pedicle.

Anatomy.—I shall not attempt in this place to describe the anatomy of the rarer forms of spina bifida, some of which, such as complete fissure of the whole spine, are incompatible with life, and therefore of no practical interest; while others, such as the multilocular tumours, those which are complicated with complete absence of vertebræ, those which arise from fissure of the body instead of the laminæ, &c., are so rarely met with that each case would require a separate description. Excluding these rarer forms, let us study the surgical anatomy of spina bifida, in the same manner as that of other herniæ, by describing the composition of (1) the coverings, (2) the sac and its neck, (3) the contents.

1. The tumour is in most cases covered by healthy and unaltered skin; frequently, however, the skin is variously modified from the standard of health. Cases are recorded in which the density of the skin was increased, so that it is described as hard and coriaceous; * but it is far more common to find the skin thinned or even altogether deficient. This is due to one of two causes; either the skin was originally properly formed, with the cutis and epidermis natural, but has become thinned as the tumour increased, or the skin has been congenitally deficient, being represented only by a thin fibrous material (something like a cicatrix) covering the spinal membranes, or even altogether absent, so that a bluish-red membrane permeated by vessels is exposed, which is the spinal dura mater. In some of these cases it is said that the latter membrane also has been absent, and the arachnoid exposed. When the coverings of the tumour are thin, serum may ooze through them without any actual hole; † but ulceration very soon takes place as the tumour increases, and then the sac bursts.

2. The sac of a spina bifida is formed of the membranes of the cord matted together; and, in some rare cases where extensive malformation is connected with hydrocephalus, this sac is lined by the substance of the cord itself, spread out into a thin layer on the inside of the membranes. Its neck is formed by an opening in the laminæ and spinous processes of one or more vertebræ, and is longer or shorter according to circumstances. When the hole in the canal is large and the tumour sessile, there seems to be no neck; while at other times the tumour hangs down over the child's back by a long stalk, which in one case is said to have been a foot in length.‡

3. The contents of the sac are, *first,* in all cases more or less watery fluid—the subarachnoid fluid; *second,* in most instances a portion of the cord itself, or the cauda equina, or some of the spinal nerves; and *lastly,* in very rare cases more or less of connective tissue, or of fat. Spina bifida is caused either by an arrest of development in the arches, or by a dropsy, probably inflammatory, of the membranes before the bones are ossified. Either cause would account for the fact, that thê malformation is far more common in the lumbo-sacral region than in all other parts of the spine put together. There are too few preparations of spina bifida in the higher parts of the column preserved, or accurately described, to allow of an opinion as to their usual contents; but it is known that in the common position of spina bifida, the cord, or some important part of it, is almost always contained in the sac.§ When the cord itself, or its pro-

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* Case iv. in Mr. Prescott Hewett's paper, *Med. Gaz.* vol. xxxiv. p. 460.

† Laborie, *Ann. de Chir.* vol. xiv. p. 272.

‡ *Boston Med. and Surg. Journ.* 1862, p. 456.

§ Mr. Hewett found only one such preparation out of twenty in which the nerves were not connected with the sac, op. cit. p. 461. The cord has been found in the sac in the dorsal region, Laborie, op. cit. p. 280.

longation, is the part contained, it is always closely united to the back of the sac in the middle line. The nerves either run across the cavity of the sac, or in the substance of its tissues, to their destination.

Symptoms.—The symptoms of spina bifida will be easily understood when its anatomy is known. The tumour is always in the middle line, and always attached to the bones. The hole in the canal can be readily felt if the parts which cover it are not very thick. If the skin is thin, the tumour has the transparence of hydrocele. The fluid can often be partly pressed back into the canal, and then tension of the fontanelle, or increase in the size of the hydrocephalus (if the latter exists), will be noticed; nervous symptoms also are frequently produced. The size or tension of the tumour is sometimes increased when the child cries. Symptoms due to interference with the functions of the cord are not infrequent—palsy of the limbs or of the sphincters, and convulsions.

The progress of the disease is usually to death. As the size of the tumour increases, the patient often dies of convulsions, or the skin ulcerates and the tumour bursts; and then palsy or convulsions produce death. But although the great majority of cases are speedily fatal, it is not always so. Many cases are recorded in which the tumour has continued to grow, but not more than in proportion to the rest of the body, and has produced no symptoms—the patient dying at various periods of some other disease.* In other and much rarer cases, the disease has undergone a process of spontaneous cure; the elongation of the pedicle produced by the weight of the tumour having resulted in closure of the orifice of communication with the spinal canal, so that there remained merely a closed cyst, which either remained innocuous or was removed. Finally, recovery has been known to follow on the rupture of the sac.

Active surgical treatment usually hastens death; yet cases have been known to recover after many varieties of operation. It is this fact which makes the interest of the disease, and renders the surgeon anxious to separate from each other the cases which should be left alone and those which should be treated actively; and, further, to assign to each class of the latter cases its appropriate method of treatment.

Treatment.—The great obstacles to the success of operations for spina bifida are the free communication between the sac and the cavity of the theca, and the probable presence of the cord, or large nerves, in the sac. In consequence of these anatomical dispositions, every active surgical measure is liable to be followed (in fact, will almost certainly be followed) by diffuse inflammation of the spinal membranes, or gangrenous softening of the cord. Now, as every true spina bifida communicates freely with the spinal theca, and as a very large majority of those of the common form (in the lumbo-sacral region) contain the cord or nerves, no further argument is required to prove the expediency of abstaining from active interference. Therefore in every case of spina bifida in which the child is in good health and the skin does not threaten to burst, nothing should be done, except to support the tumour by means of a concave shield well padded (which may make slight pressure if no pain is produced thereby), and watch the case, in the hope that the disease may remain stationary —perhaps even undergo a spontaneous cure. But what course is to be pursued in cases where the tumour is increasing rapidly, and where the thinness or ulceration of the skin proves that the sac will soon burst; or where it has once burst and the infant has survived; or where convulsions have come on and are frequent and severe; or where hopeless paralysis renders life a burden? It is obvious that in any of these cases the child's condition can hardly be made worse; and the only question is, whether there is enough prospect of doing good to induce the surgeon to risk the reputation of himself and his art by attempting anything. Let us recur to our previous statement of the chief obstacles to success, and see whether they can be in any way obviated. The first of these obstacles is, the free communication of the sac with the cavity of the spinal membranes. If, then, this communication could be temporarily obstructed, the interior of the sac might be treated by injection, as congenital hydrocele sometimes is, without any propagation of the inflammation to the general cavity; or might, perhaps, tolerate some of the other methods of treatment to be alluded to presently. In other words, pedunculated tumours are much more favourable for treatment than those that are sessile. Next, as to the presence of the cord. If it be present, it is united to the back of the sac in the middle line, and cannot be reduced or got rid of in any way. The injection of iodine would most likely set up such an amount of inflammation as would lead to paraplegia;* while ligature or any sanguinary operation must be inevitably fatal. To judge whether the cord is or is not present, we have only probabilities to guide us. The probability of the presence of the cord or large nerves varies according to whether the tumour is pedunculated or no. If the opening into the canal be very small (especially with a voluminous tumour), the cord is the less likely to pass through it, and *vice versâ*. If the tumour can be tapped, and the fluid drawn off without producing nervous symptoms—if there is no increased sensibility in the usual place of attachment of the cord—if the disease, though increasing, is not attended by convulsions—if the tumour is equable in transparence and consistence throughout—if, on tapping the tumour, the trocar can be passed into the centre of the sac without appearing to set up such symptoms as we should expect from touching the cord—we may fairly act on the assumption that the cord is absent. In cases where it is suspected that the cord is present, no treatment should be adopted, except in express deference to the wishes of the child's parents, and with a full knowledge on their part of the probability of a fatal result.

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* The most advanced age to which any patient has been known to survive seems to be fifty; v. Behrend in *Journ. f. Kinderkrankheiten*, vol. xxxi. p. 350. A curious case is recorded in the *Bull. de la Soc. de Chir.* 1860, p. 396, of a man who lived to the age of forty-three, having survived a very complicated operation for the stone, and died of a recurrence of the latter disease.

When the rapid increase in the size of the tumour is the only symptom requiring surgical interference, no more active measures should be employed, until the effect of repeated tapping, followed by the application of pressure cautiously and gradually, has been ascertained. In this way Sir A. Cooper obtained two very gratifying successes.† The tapping should be performed with a fine trocar, introduced always on one side (remembering that the cord, when it is present, is always attached in the middle line), and the tumour should not be entirely emptied at first. After a portion of its fluid has been removed, a pad and bandage, or some apparatus in the form of a bag-truss, may be used; or the skin may be painted with collodion, either without puncture or after puncture, the wound having been allowed to heal. If the skin is very thin, the collodion should be used at first diluted with equal parts of castor-oil. A thick layer should be painted on, and the part kept exposed to the air till the fluid has completely dried (say an hour and a half). In a case reported by Behrend,‡ this plan proved perfectly successful; combined, however, with the internal administration of calomel.

But when the tumour refills as fast as it is emptied by the trocar, some other method must be practised if the child's life is to be saved. The operations which have been used are (1) injection, (2) ligature, (3) excision. Issues and setons have also been employed, but not since the anatomy of the disease has been understood. Their use would now be quite unjustifiable.

1. Injection of the sac is by far the most promising method. Tincture or solution of iodine is the only fluid with which, as far as appears, the experiment has been made; and its success has been sufficient to make us hesitate before using any other agent. In fact, it is difficult to conceive of any other which would unite in so great a degree efficacy with harmlessness. There are two principal methods of using iodine injections in this disease. By the

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* See a case by M. Viard, *Bull. de la Soc. de Chir.* 1860, 2^{me} sér. tom. i. p. 616.

† *Med. Chir. Trans.* vol. ii. p. 324.

‡ *Journ. f. Kinderkrankheiten*, vol. xxxi.

first, which we may call the American method, the sac is not emptied, but a certain amount of the fluid is drawn out of it, and its place supplied by the iodine solution. Even this mixture is sometimes withdrawn from the sac, after having been left to act upon its lining-membrane for a few minutes. This was the method adopted by Brainard of Chicago.* In the other, or the French method, introduced by Velpeau, all the fluid is withdrawn from the sac, which is then injected with tincture of iodine and water, like a common hydrocele. Numerous successes are claimed for both methods. Dr. Caradec of Brest operated on three cases by iodine injection; two were cured, and in the third case success appeared probable, when some imprudence, on the part of the child's mother, led to a fatal issue.† In a report on this subject, published by M. Debout in the *Bulletin de la Société de Chirurgie de Paris*, 1860, p. 612, the reporter states that Brainard had operated in 6 cases, 5 of which had been successful; and that Velpeau's method had been adopted in 10 cases, of which 5 were cured, 4 died, and 1 failed. I must confess that I look on these figures with some slight suspicion. Brainard himself, in reporting a seventh case, gives what seems quite a different version of his success. He says,‡ that he has treated 7 cases of spina bifida with iodine injections; that 3 out of those cases were uncomplicated with hydrocephalus, and that all these 3 were 'perfectly and permanently cured.' There is, however, I think, no doubt that injection has proved far more successful than either of the other two plans, and should always be used, when not plainly contra-indicated, in any tumour in which active treatment is considered necessary. It is highly desirable, if possible, to stop the communication with the spinal canal, in order that the injection may not excite inflammation in the cavity of the membranes. Therefore, those tumours which are pedunculated, or have a very small orifice, are best suited for this treatment. Superficial tumours are also more likely to be successfully treated than those which are covered with a mass of soft parts, on account of the impossibility of commanding the orifice in the latter.

2. The ligature of the pedicle of the tumour, by instant strangulation, has been practised frequently; but, I believe, always with fatal effect. The gradual compression of the pedicle by means of quills laid on either side, and brought gradually towards each other, was devised by Benard; § and Dubois effected the same purpose by means of a clamp placed on the neck of the tumour.‖ It does not seem essential to the success of this operation that the tumour should be removed; but when the neck has been divided, it may be as well to do so. This plan would be only applicable to the same kind of tumour as the iodine injection, and it appears far more dangerous.

3. There remains the operation of excising the sac. As several cases of successful excision are on record, it would, I think, be rash to proscribe the operation in a disease so fatal in itself as spina bifida. The tumour, if covered with healthy skin and fat, may be laid bare, and the cyst opened by an incision on one side of the middle line, cautiously enlarged to the extent necessary to see into its interior. If the cord or large nerves are seen, the operation must be given up. Otherwise the sac is to be removed, a portion being retained large enough to cover the orifice in the canal

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* Brainard's method of operating is thus described by himself. Six ounces of fluid were drawn off; half an ounce of a solution of 5 grs. of iodine and 15 of iodide of potassium to the ounce of water was injected, then, after a few seconds, allowed to flow out; next the sac was washed out with water; and finally 2 oz. of the original cerebro-spinal fluid (kept for the purpose at the temperature of the body) was reinjected. All this was done under chloroform, and pressure was afterwards applied. Brainard, op. infr. cit.

† *Union médicale*, 1867, pp. 402, 467.

‡ *Am. Journ. Med. Sc.* 1861, vol. xlii. p. 65.

§ *Gaz. méd. de Paris*, tom. ix. p. 573. A successful operation on this plan by M. Latil is quoted by M. Larcher on p. 109 of his translation of my work on the *Surgical Treatment of Children's Diseases*, from the *Bulletin de Thérapeutique*, tom. i.

‖ Laborie, op. cit.

completely. This portion is to be implanted into the tissues around the orifice by points of silver suture, and the integument united over it. The only prospect of success for this operation is the faint chance that the parts may heal over the orifice of the sac, without such an amount of inflammation as would spread to the general cavity of the membranes. I have operated once in this manner; but the result was fatal. In a successful case in France,* the écraseur was used to divide the neck of the sac ('*je ne sais trop pourquoi*,' says the reporter of the case naturally enough); and though a hole was left into the spinal canal larger than the end of the finger, the patient (fourteen years of age) recovered without a bad symptom. The following note appears on p. 111 of the French translation of my work on the *Surgical Diseases of Children*:—'Excision followed by suture, as recommended by Brunner, has been practised by Trowbridge, and afterwards by Dubourg, in three cases, and twice with success. The sac being opened, the opening into the spinal canal was closed by the finger and the superfluous part of the sac removed, so that what remained could be brought down and united accurately at the situation of the opening, by means of the twisted suture. This description is taken from a work of Bouchut. M. Royer and M. Nott have also employed this method, more or less modified, and both unsuccessfully. (Royer, *Bull. de l'Acad. de Méd.* vol. xxxi. p. 33; Nott, *Gaz. méd.* 1856, p. 102.)'

Dr. Wilson of Claycross has removed a spina bifida twice with success. In the first operation,† he previously compressed the pedicle of the tumour (which was in the dorsal region) with a clamp; the object being to induce a new action in the pedicle and the secreting sac, to isolate the latter partially, and to ascertain the constitutional effects of interference with the neck of the tumour. This being well borne, the tumour was removed, the edge of the membranes touched with a red-hot knitting needle, and the skin united with wire sutures. The child recovered perfectly. In the second case, the tumour was over the last lumbar vertebra; the child, two years old, was in a state of great exhaustion, and there was constant discharge from the wall of the sac, which was thin and membranous. The tumour was removed as in previous cases, but without any previous use of the clamp, and the child recovered perfectly.

Signor Rizzoli of Bologna,‡ removed a cervical spina bifida, by means of the clamp, or entérotome, applied to the neck of the tumour, so as to bring its parietes into accurate apposition. The sac sloughed, and was removed on the fourth day, and the clamp was taken off on the following day. The child recovered completely, and the hole (which was in the fourth vertebra) rapidly cicatrised.

The same surgeon relates a most interesting case under the care of Signor Berardi, of a large and long spina bifida in the coccygeal region, and much resembling a tail, which hung down to the middle of the leg. This was cured by repeated evacuations of its fluid contents, and the obliteration of its pedicle by pressure with pieces of wax bougie, followed by the amputation of the appendage.

Another method of operating with the knife, though it can hardly be called excision, has been practised by Mr. Borlase Childs.§ It consists in opening the tumour, pushing its collapsed parietes back into the canal, and uniting the soft parts over all, tightly enough to prevent the re-protrusion of the sac. The only attempt yet made in this way was fatal; and I confess that it seems to me even more dangerous than excision.

I do not think we are in a condition to point out in what cases each of these methods of operating is indicated; but as far as the limited experience, above referred to, would justify a conclusion, it would seem that the total excision of the tumour does not involve more risk than the method of ligature. Dr. Wilson, whose practical experience in this matter entitles his opinion to respect, urges the applicability of the method to cases of pedunculated tumours, in which symptoms persisting, in spite of milder treatment, seem to justify operative measures. And no doubt, there is much less risk in operating on a tumour which, being pedunculated, is less likely to contain the spinal cord or larger nerves, and whose channel of communication can be commanded while the sac is being removed. But then there is less likelihood of need for operation in such cases, since they are just those which are most amenable to pressure or injection. In cases where the tumour is sessile, and where the symptoms call for operation, excision is the only available resource; but it is far less likely to succeed. Thus it was in my case, referred to above, and which proved rapidly fatal from diffuse meningitis.

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* *Bull. de la Soc. de Chir.* 1860, p. 664.

† *Path. Soc. Trans.* vol. xiv. p. 214.

‡ *Memorie chir. ed ostetriche*, vol. ii. p. 565.

§ Behrend, op. cit. case 19.

In some works* will be found a tabular statement of the supposed indications and counter-indications to operative measures in these cases; but such elaborate statements, while far from being beyond criticism, do not appear to be of much practical utility. No case of spina bifida ought ever to be subjected to any active operative interference, except in the most urgent circumstances; and in every case the mildest measure which holds out any rational prospect of cure should be the one selected.

False spina bifida.—This term includes several perfectly different forms of superficial tumour, all of which agree in this leading feature, that they communicate with the cavity of the spinal canal, but not with that of the membranes. They are, 1. The sacs of true spina bifida, the necks of which have become obliterated, and which have thus become detached from the membranes. 2. Congenital tumours. 3. Included fœtal remains. Like the true spina bifida, these are more common in the lower part of the column.

1. Pedunculated sacs, which communicate with the spinal theca by a narrow channel, may have that channel closed, either by inflammation occasioned by the dragging of the tumour and the pressure of the parts around, or by the growth of the bones encroaching on the membranous tube. Such is believed to have been the history of a remarkable case, which Mr. Solly has recorded in vol. xl. of the *Medico-Chirurgical Transactions.* It must be allowed that the precise nature of the tumour in this case is doubtful; but other instances (although very few) of this kind of spontaneous cure are recorded.† Its occurrence would be known by the obliteration of the tube of communication between the sac and the laminæ, and the feeling of those bones ossified beneath the tumour. Under these circumstances, an operation for the removal of the tumour is justifiable, though it can hardly be considered necessary.

2. Congenital tumours inside the spinal canal are of very various kinds. The most important are found in the sacral region, and these have been discussed in a preceding page (799).

3. The question of included parasites has also been discussed above.

In considering the question of removing a false spina bifida, its connection to the spinal canal, and to the great cavities of the body (as the pelvis), must be carefully investigated; and in the pelvic region a thorough examination of the rectum and genital organs must be made. If the tumour is free from both these sources of danger, it may be operated on without scruple. If it be in such close connection to the canal as to lead to the inference that it springs from its interior, but still, from its unvarying size under pressure and from other circumstances, a hope is entertained that it may have no communication with the membranes, it may be made the subject of treatment, should the symptoms justify interference. In that case, if the tumour be purely cystic, iodine injection is no doubt the proper measure; but in mixed cystic tumours this will probably fail. It may be tried, however, if the cyst bears a large relation to the bulk of the whole tumour; and it is not till after its failure that it would be advisable to debate the very difficult and doubtful question of excision.

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* E.g. Behrend, op. cit., adopted from Laborie.

† In a debate at the Soc. de Chir. de Paris (*Bulletin*, 1860, p. 387), M. Debout is reported to have said that he only knew of five cases of spontaneous cure: three in the coccygeal region, and two in the lumbar.

Imperforate rectum is a deformity which, though sufficiently rare to prevent most practitioners from having much individual experience of it, is yet common enough to cost the lives of many children every year. Now most of those who have seen much of children's diseases will agree that the lives of the majority of these patients might have been saved, and the patients restored to perfect health, by very simple means, had the medical attendant been more familiar with the nature and treatment of the deformity. In some cases, it is true, life can hardly be preserved; in some it can be preserved only at the cost of the infirmity of an artificial anus; but these are the minority; in the greater number, if a very simple operation be performed promptly, no traces of deformity will remain in after life. It is very important, therefore, to be familiar with the several kinds of this malformation and with the treatment which each of them requires.

Cases are sometimes met with in which the anus is only partially obstructed. Of this rare form of malformation the following instance occurred to me. A female infant a few days old was sent to the Hospital for Sick Children, who had a fæcal fistula in the back part of the vagina, but was said to pass fæces also naturally by the anus. Believing, however, that such a fistula could only be accounted for by a congenital defect, I examined the anus, and found it would hardly admit a common probe. The rest of the aperture was blocked up by a membrane of no great thickness. The fistula which communicated with the vagina was much larger than the orifice of the anus; so that hardly any fæces passed by the latter. I enlarged the anus to the proper extent by freely incising the membrane, and keeping the part dilated with a good-sized bougie. By the time the anus would easily admit the little finger, the fistula seemed nearly closed, and little or no fæcal matter passed. After this I lost sight of the patient.

Cases of imperforate rectum may be divided into two classes, viz. those in which no anus exists (imperforate *anus* properly so called), and those in which there is an anus leading into a cul-de-sac (imperforate *rectum* in the narrower sense of the term). The former class (imperforate anus) may be again subdivided into—1. membranous obstruction of the anus; 2. complete or partial absence of the rectum; 3. communication of the rectum with the vagina in the female; 4. communications with the urinary tract in the male; 5. external communication, or fistula. The latter class (imperforate rectum) may be subdivided into—1. membranous obstruction; 2. deficiency of the upper portion of the rectum.

Imperforate anus is so far a less dangerous affection than imperforate rectum, that it attracts immediate notice. Either at the time of delivery, or very soon after, the medical attendant or the nurse observes that the natural opening is absent, or that there is an unnatural one. In cases of imperforate rectum, on the other hand, the malformation is overlooked, and the child's sufferings are at first attributed to every cause except the right one.

A. *Imperforate Anus.* 1. *Membranous obstruction.*—When a child is born with imperforate anus and without fæcal fistula, the first question is, whether it is not merely an example of the first of the five subdivisions above enumerated. These cases of membranous closure of the anus constitute, I believe, a great majority of the whole; and a simple incision obviates all danger to life. This simple variety is known by the bulging, at the situation of the anus, which is seen when the child cries; and also, if the membrane is thin, by the colour of the meconium being seen more or less distinctly through it. But in order that either of these signs may be noticed, the gut must be distended with meconium, which is not always the case at the time of birth. However, if the gut be not full, the child will not suffer any inconvenience; so that in a case of imperforate anus where no bulging can be seen, and no symptoms are present, it is right to wait for a certain time (varying with the progress of the case, a day may be taken as an average), in order to allow time for the descent of the meconium, before undertaking any treatment. When bulging is perceived, all that is necessary is to make an incision of sufficient size in the situation of the natural anus, and give exit to the contents of the gut. This being done, some of the tissue on either side of the incision may be cut away, in order that the opening may be less liable to close, and it must be maintained open by passing a small bougie, or the end of the finger, into it daily, or twice a day, for some weeks. Whether the incision is to be a simple one in the middle line, or a crucial one, appears to be a matter of indifference; but the former is quite sufficient, and the latter is open to the theoretical objection that the fibres of the external sphincter, which is present in these cases,* may be injured. After this operation, if indeed a proceeding so simple deserves the name of an operation, the infant is usually restored immediately to perfect health, and the parts in after life have all the natural appearance and functions. But if no treatment be undertaken (which is unfortunately too common, in consequence of a kind of general impression of the necessary fatality of the malformation), the abdomen becomes tumid and hard, the infant refuses the breast, vomiting comes on, which soon becomes stercoraceous, and the patient dies in a few days from exhaustion, or more rapidly from bursting of the intestine.† If the symptoms have come on before the child is seen, the aspect of the case is less promising; but the same course should be pursued. In a case under my care, in which the child was in a state of great distress from distension and fæcal vomiting, rapid recovery ensued on the restoration of the natural passage.

2. *Complete or partial absence of the rectum.*—When no bulging is perceived, after waiting for a reasonable time, it is probable that the lower end of the rectum is deficient. In such a case, if the external parts exhibit no obvious malformation, an exploratory operation should be performed, the object of which is to discover the end of the rectum, and if possible to draw it down, and attach it to the skin in the situation of the anus. For this purpose a free incision should be made from a short distance behind the scrotum, or vulva, in the middle line, to the point of the coccyx; the parts should be carefully dissected, the dissection being conducted along the front of the coccyx and sacrum; and if a bulging tumour can be felt, it should be gently drawn downwards by means of hooked forceps and brought down, if possible, to the skin, attached there by sutures on either side, and opened; but if this is not possible, it should be opened *in situ*, and after the evacuation of the meconium, gentle traction by forceps should be used to draw it down as far as possible. If the gut can be attached on either side to the skin, the risk of subsequent contraction of the orifice is much diminished, and the danger of extravasation of fæces into the cavity of the pelvis avoided. If this cannot be done, the opening must be maintained by the daily passage of a bougie, or other dilating instrument. I have found a pair of dressing forceps a convenient instrument for gently dilating the opening. If the opening can be kept to a proper size, even when the gut has not been drawn down, the power of controlling the fæces may be hoped for. A sphincter muscle has been proved by dissection to exist in a case of this kind of malformation: but if the gut have been attached to the skin, its circular fibres will assume the office of a sphincter, even when no external sphincter exists.

When the rectum is entirely absent, the above proceeding will fail. The dissection will disclose no bulging tumour; and then the surgeon will be justified in proposing to open a higher part of the large intestine, and form an artificial anus, in order to save the child's life. The questions connected with this operation will be considered presently.

In cases of imperforate anus where malformation is obvious externally, the parts of generation being very far back, the tuberosities of the ischia very near together, and perhaps the skin in the situation of the anus much depressed, there is more reason to fear that the rectum is altogether wanting, and more danger of wounding the male bladder, or the female uterus and vagina, and the peritoneal pouches, in the dissection, than where the parts are more naturally formed. In such cases, the exploratory operation must be conducted with great caution; and if the above characters are very marked, it will become a serious question whether it would not be justifiable to resort to colotomy at once. It will, however, in most (if not in all) cases be possible, and be the more prudent course, to make an opening between the coccyx and the parts of generation sufficiently large to introduce the finger and feel for the rectum; but in these cases great care must be taken not to injure the parts in front.

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* See *Path. Soc. Trans.* vol. v. p. 176.

† The intestine has given way as early as the fourth day. *Path. Soc. Trans.* vol. ii. p. 226. Curling, *Med.-Chir. Trans.* vol. xliii. p. 305.

3. *The rectum communicating with the vagina.*—The third variety of imperforate anus is that in which the rectum ends either by a small sinus, or by a continuation of its entire tube, in the posterior commissure of the vagina. This is a far less serious defect primarily than the former, since the fæces pass in sufficient quantity to avoid any serious symptoms, and an infant does not suffer any material inconvenience from the flow of fæces through the vagina. Hence the parents often do not present the child for treatment till it is several weeks or months old. But the secondary consequences of the deformity are usually very serious. The sinus is often not large enough to permit of a sufficient evacuation of the gut, when, with advancing life, the fæces become more solid. This gives rise to increasing distension of the colon, which has sometimes proceeded to a frightful extent and proved the direct cause of death.[*] Besides, the disgusting nature of the infirmity calls for prompt treatment before the child is old enough to be sensible of its inconveniences.

The inconvenience caused by a communication between the rectum and vagina vary very considerably. Thus a case has been recorded by M. Le Fort[†] in which a married woman was discovered on rectal examination to have imperforate anus, the rectum opening obliquely into the back of the vagina. In this case the command over the fæces was so perfect that no inconvenience resulted; and neither she, nor her husband, nor the accoucheur who had delivered her three times, were aware that there was any peculiarity about the sexual organs. Such cases as these should not be interfered with. On the other hand, when the communication is either so small as to oppose an obstacle to defæcation, or so large and destitute of sphincter-power as to entail the disgusting consequences of recto-vaginal fistula in after life, no time should be lost in commencing the operative treatment. The latter is often very difficult and complicated. I have now under treatment a girl about seven years of age, whom I saw in early infancy, and on whom I have performed numerous plastic operations, at intervals, during the whole of that time. The cure is now almost complete.

Signor Rizzoli[‡] has given an interesting account of four cases of this malformation, in all of which he succeeded in restoring the parts completely to their natural relations and appearance by dissecting away the end of the rectum from the back of the vagina, through a free incision in the median line, and then bringing down and fixing the end of the gut in the natural position of the anus, after which the parts between the anus and vulva were united by sutures so as to form the new perinæum. In some of the cases the lower portion of the rectum was so contracted that it was necessary to open it freely in order to obtain a sufficient anal orifice; and in some cases the difference in length between the anterior and posterior walls of the gut, due to its curved direction, caused some difficulty in drawing it down to the proper position. This difficulty however was overcome by careful dissection. The accompanying figures from Sig. Rizzoli's work well illustrate this method of operation.

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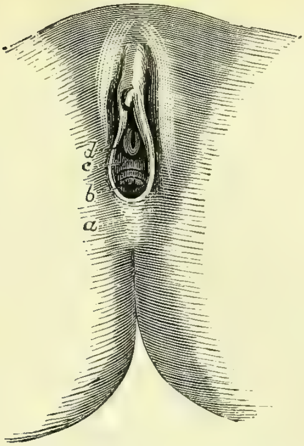
[*] *Brit. Med. Journ.* 1858, p. 845.

[†] Le Fort, *Des Vices de Conformation de l'Utérus et du Vagin.* Paris, 1863, p. 120. M. Ricord also has put on record a case in which a woman was in the constant habit of sexual intercourse, and had lived with one man for three years, without his suspecting any malformation. *Gaz. des Hôp.* 1833, p. 412.

[‡] *Memorie chirurgiche ed ostetriche*, vol. ii. p. 321. Bologna, 1869.

Fig. 409.



The parts before operation. *a*, the perinæum, extending to the coccyx. *b*, the opening of the rectum into the vulva. *c*, a fibrous membrane continuous with the hymen (*d*), and uniting the labia majora to each other and the rectum.

Fig. 410.

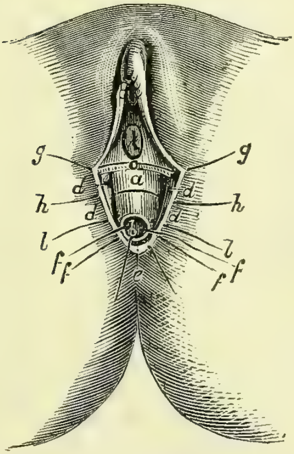
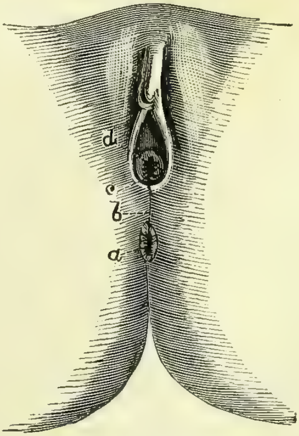


Diagram of the operation. *a*, the lower part of the rectum, which has been exposed by a free incision in the median line, extending through the tissue marked (*c*) in the last figure, and drawn down towards the coccyx (*e*). *b*, anal opening of the rectum. *c*, remains of the membrane continuous with the hymen. *d d d d*, the divided muscles and other tissues of the perinæum. *f f f f*, two sutures passed through the lower end of the rectum, securing it in its new position. *g g*, *h h*, sutures, reuniting the divided perinæal tissues. *l l*, a suture uniting the perinæl tissues to the anterior edge of the rectum.

Fig. 411.



The parts after operation. *a*, the anal orifice of the rectum in its normal position. *b*, the median incision united and forming the raphé of the new perinæum. *c*, remains of the tissue marked with the same letter in the previous figures. *d*, the hymen, somewhat displaced backwards by the tense membrane *c*. This was the only abnormal appearance which the parts presented after the operation.

There is usually no difficulty in finding the end of the rectum, by passing a director down the unnatural opening. The perinæum should then be freely divided from a short distance behind the posterior commissure of the labia nearly to the coccyx: and after having, if necessary, opened the rectum by cutting on the director, the operator should endeavour to draw down its walls, separating the front wall from the vagina, and attach them to the skin. If this cannot be done, at any rate a free opening must be maintained in the situation of the natural anus, in the hope that the recto-vaginal fistula may close, which, if it be small, appears to be the case tolerably often. If it does not close, some plastic proceeding analogous to that which is used for rupture of the perinæum in the adult will probably be necessary. But for the success of such operations the bowels must be more under control than can be the case in early infancy; so that it is advisable to delay the operation, and to ascertain, by experiment, before performing it, that the child's bowels can be kept constipated for several days without danger. Dr. Rhea Barton succeeded in effecting a cure by the simpler method of lying all the parts open from the vaginal fistula down to the natural situation of the anus, and then encouraging the front part of the wound to close, while the back part was kept open. Another American surgeon successfully repeated the same operation.*

4. *The rectum communicating with the urinary tract.*—Communications between the lower end of the bowel and the male urinary organs with imperforate anus constitute perhaps the most troublesome variety of this affection. It is true that the malformation does not prove immediately fatal, since the fæces are at first sufficiently liquid to pass by the urethra without much residuum. But as they become more solid, a residuum is left, which, being impacted in the urethra or bladder, according to the level of the communication, produces the ordinary symptoms of calculus, with perhaps even more than the ordinary amount of retention of urine. It is important, therefore, to operate before this has taken place. The communication may be either with the urethra or the bladder. In the former case, it may in some instances possibly be discovered by the sound; but usually the seat of the communication remains uncertain. Should the gut terminate in the urethra the rectum will only be deficient in its lowest part, and its termination will be accessible from the perinæum. Therefore, the proper course is to begin by performing the usual exploratory operation in the perinæum; and if the rectum be met with, to separate it from its connections, if possible, and draw it down to the skin, as in the last case. I am not aware, however, of a case in which this has been successfully accomplished. If the rectum be not found, the inference is that the communication is with the bladder; and in that case the rectum may be totally absent, and the communicating intestine may be some much higher part of the alimentary tube. In such a case, I think that colotomy should be recommended; but it is a very doubtful question, the decision of which may reasonably be left to the parents, if they are persons of sufficient intelligence. Some further remarks on colotomy in these cases will be found in a future paragraph.

If the child is not seen till a later period, when the symptoms of fæcal accumulation in the urinary tract call for some relief, attention must first be directed to this accumulation. The mass must be broken down with the catheter, and removed by the free injection of warm water; or if it be very solid, it may even be advisable to use the lithotrite. Then the case must be treated according to the rules above laid down. The proposal, which has been sanctioned by some surgeons, of cutting down in the middle line into the urethra and neck of the bladder, and thus lying the whole track for the urine and fæces into one, appears unadvisable, as it would very likely end in leaving the patient with the horrible infirmity of a large cloacal aperture, through which both the urine and fæces would pass without control.

5. *Imperforate anus with fæcal fistula.*—The cases of imperforate anus in which a fistula exists opening externally are not immediately threatening to

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* Bodenhamer, *Congenital Malformations of the Rectum and Anus.* Cases cxcvii. xcviii.

life; and if the external opening be in a situation where the discharge of the fæces will not be dangerous or very inconvenient (e.g. behind the natural position of the anus), it may be a question whether they require any treatment beyond such dilatation as may be necessary for the perfectly free discharge of the fæces. Such openings have been known ultimately to acquire sphincter power. But when the opening lies in front of the natural position (in the scrotum, or close to the vulva, according to the sex), it is advisable to cut down in the proper place, and attach the gut to the skin. The operator may be sure of finding the rectum lying close to the skin of the perinæum. If the abnormal anus be in some remote place (as in the hypogastrium, on the dorsum penis, in the groin), the case assumes a much graver aspect, since the rectum, and perhaps the whole large intestine, may be absent or impervious. In most of such cases it will, in all probability, be judged better to dilate the abnormal anus, if necessary, and abandon the case to nature. In very few instances would it be justifiable to attempt to restore the natural opening.

B. *Imperforate rectum.*—We have now to consider the cases of imperforate rectum in the narrower sense of the term, i.e. cases in which the external parts are normal, but the anus leads into a small cul-de-sac, the rectum being totally obstructed above. Such cases (as has been before pointed out) usually require immediate treatment; the deformity having been at first overlooked. The obstruction of the rectum may be due to a simple membrane stretched across the tube of the intestine, which in other respects is natural; or the upper tube (the rectal cul-de-sac, as it is called) may lie by the side of the lower (the anal cul-de-sac), or behind it; or the rectum may be impervious for a greater or less distance, so that the colon may terminate by a dilated extremity above the pelvis. In rare cases, the sigmoid flexure itself, and more or less of the rest of the large intestine, may be absent; but as such infants are usually not viable, the cases present little practical interest. Practically, cases of imperforate rectum may be divided, as above, into two classes, i.e. 1. where the upper cul-de-sac is accessible from the lower; and 2. where it is not.

The chief means of distinguishing one variety from the other is the sensation of bulging communicated to the finger passed into the anal cul-de-sac. The presence of this symptom may be taken as indicating that the two cul-de-sacs lie close together. As a matter of prognosis, it ought to be borne in mind that this bulging has been felt in a case where it proved to be due not to the impulse of fæces in the rectum, but to that of fluid in the recto-uterine pouch of the peritoneum;* but as an indication for practice it may always be held to justify the surgeon in exploring the bulging tumour. This may be done either by incision or with a grooved needle. If a puncture is made and meconium escapes, the puncture ought to be dilated with a pair of dressing forceps passed through it, until the meconium has been freely discharged, when a large catheter or tube should be fixed in the gut. If the surgeon prefers to use a grooved needle, and meconium is detected, the grooved needle may be used as a director, and a small knife be passed along it. M. Guersant has recommended the use of a trocar and canula made in a peculiar form, so that the canula is grooved; but as a grooved needle answers every purpose, I should not be disposed to use a larger instrument. The practice usually pursued, of thrusting about trocars of considerable size in the tissues of the pelvis, is very dangerous; and if the gut is found, the opening made by such an instrument is always insufficient; so that the trocar ought to be discarded in these exploratory operations.

Numerous instances are on record in which the surgeon has failed to detect the presence of the rectal cul-de-sac with the trocar, although that portion of the bowel has lain close to the anal cul-de-sac. I have figured such a case in my work on the *Surgical Treatment of Children's Diseases,* p. 172, in which Littre's operation was subsequently performed, under the impression that the lower bowel was totally deficient. A similar case, under the care of the late M. Robert, is figured by M. Larcher in his translation of the above-named work, and I reproduce it here, since it illustrates another point which will be referred to further on.

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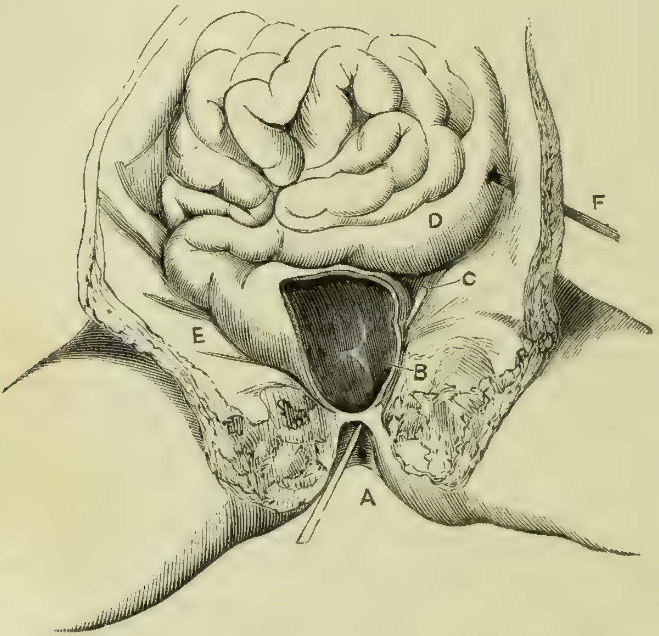
* *Path. Soc. Trans.* vol. xi. p. 99.

FIG. 412.



Imperforate rectum. Failure of exploratory puncture. Littre's operation. A, anal cul-de-sac. B, rectal cul-de-sac. C, probe passed in the course of the trocar, which had been thrust behind and to the left of the bowel. D, descending colon. E, the sigmoid flexure passing over into the right groin. F, the colon opened by Littre's operation in the left groin.

If the gut cannot be found in this way (i.e. if there is no bulging tumour, or if the sensation prove deceptive), an operation similar to that for imperforate anus should be first performed. The anal cul-de-sac should be freely laid open towards the coccyx, and the parts in the pelvis dissected to as great a depth as may be thought prudent. On the failure of this operation, the question of colotomy will arise.

Colotomy in congenital obstructions of the lower bowel. When the rectum is entirely deficient, the only means of preserving life is to open some higher part of the bowel; and when the gut opens into the bladder, and is inaccessible from the perinæum, the same operation may be performed, although not immediately necessary for the preservation of life, as a means of avoiding the grave inconveniences and dangers which that malformation entails. The operation may be performed either according to Littre's method, or that which goes by the name of Amussat.* But the former is generally preferred in these cases of congenital malformation for several reasons, although it must be allowed that our experience of either is not sufficient at present to serve as a foundation for any very exact comparison. It may be said, however, that the only difference between the two operations is, that Littre's is performed a little lower down and farther forward than Amussat's, and that the former necessarily opens the peritoneal cavity, while the latter may succeed in opening the intestine without wounding the peritonæum, in those cases in which the descending colon is not attached by a mesentery. But the latter advantage cannot be always attained, since the presence of a mesentery is not uncommon; and if there be a very long mesentery, it may be altogether impossible to find the large intestine.* Nor does it appear at all certain that the fatality of colotomy in these cases is due in any great measure to wound of the peritonæum. The tender age of the child; the weakness induced by distension, vomiting, and want of nourishment; and the tendency to peritonitis (in some cases its actual existence), from the congestion and straining motions of the intestines, sufficiently account for the fatal result which usually follows.†

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* These operations are described in vol. iv. p. 636 et sqq.

M. Guersant opened the colon eleven times in the groin, and once in the loins, without saving one of his patients.‡ I have only been able to find a single successful case recorded since the publication of M. Rochard's paper,§ although that publication must have given rise to the performance of many similar operations. In that case,‖ which occurred under the care of Dr. Pooley, in the State of New York, the operation was performed on an otherwise healthy male child in whom there was imperforate rectum and a communication with the bladder. The report was published six months after the operation, the child being then in perfect health. The fæces passed about twice a day from the artificial opening, and the fæcal discharge from the bladder appeared to have quite ceased. M. Giraldès, however, had a case of colotomy for imperforate anus in which the child lived 2½ months, and died from another cause.¶

In the rare cases where colotomy has been successful, some of the patients have lived through the ordinary term of human life, and have been able to perform without serious inconvenience the duties of laborious occupations, and the functions of wives and mothers.** These cases justify the performance of the operation, with the consent of the patient's friends, although it must be admitted that little success can be anticipated.

When the operation has been performed on account of a communication with the bladder, an additional annoyance is experienced in the fact that some fæces may still pass beyond the artificial anus and reproduce the symptoms of vesical irritation. The surgeon must either deal with the symptoms as they arise, by breaking down the masses in the bladder from time to time, or he may make trial of a plug inserted into the lower opening, or he may even feel justified in attempting to cure the latter by a plastic operation. Space will not permit of a discussion of this rare complication; an interesting example of which is, however, recorded by Mr. Curling.††

A curious discussion has been originated by M. Huguier,‡‡ viz. whether, in performing Littre's operation in cases of imperforate anus, it would not be better to operate in the right groin instead of the left. He has noticed that in many cases of total absence of the rectum, the oblique bend in the colon, of which I have just spoken, brings it to terminate in the right groin. Hence he recommends to make the incision on this side instead of the left. But all the successful cases which have been put on record have been operated on in the left groin; while no operation, so far as I know, has yet been practised on Huguier's suggestion, except one, which is related by Mr. Bryant in his work on *Surgical Diseases of Childhood*, p. 40. In this case, after failing to reach the bowel by an exploratory operation in the perinæum, Mr. Bryant cut down on the right side by 'a vertical incision, at the distance of one inch from the anterior superior spinous process, towards the umbilicus,' and at once found a portion of large intestine, which was proved, after the death of the patient, to be the descending colon. This case, then, shows that M. Huguier's suggestion is so far practicable, that in some, at any rate, of these cases of malformation it is possible to reach the descending colon on the right side of the belly. The same fact is shown by a case which I have related in my work on *Children's Diseases*, p. 166; and by a case recorded by Mr. Ashton in the *Path. Soc. Trans.* vi. 200, and many others. But this by no means settles the question. Allowing that in some cases the sigmoid flexure of the colon may be reached from the right side, two questions present themselves: 1. In these very cases could not the large intestine have been opened also from the left groin? 2. If not, is the proportion of such cases sufficient to justify the proceeding? With respect to the first question, I cannot find any precise details on which to found an answer. Mr. Bryant does not describe the relations of the colon in his case in terms sufficiently precise to show that he had given particular attention to this point. In M. Robert's case, figured on page 816, it is plain that the colon could have been found with equal ease in either groin. In Mr. Ashton's case in the *Path. Soc. Trans.* vol. vi. he says, that 'the ascending and transverse portions of the colon were normal: this intestine then descended a short distance on the left side, and, recrossing the abdomen to the right side, terminated in a dilated pouch,' &c. Here, then, if the operator had cut down on the left side, and had not found the large intestine, enlargement of the wound upwards (not necessarily to a very great extent, considering the size of the parts) would have brought the descending colon into reach. What M. Huguier says may be very true, that from the right groin some portion of the large intestine is sure to be reached; but it seems to me to be by no means a matter of indifference whether the part opened be the descending part of the colon or the cæcum; and unless it could be shown that the sigmoid flexure is always, or almost always, on the right side, I should be decidedly in favour of the operation on the left side. The reverse, however, is, I think, very clearly shown. Thus M. Giraldès says,* 'Numerous anatomical investigations, together with the records of those of Curling and Arthur Bourcart, have shown me that in the great majority of cases in the fœtus and new-born child the sigmoid flexure is placed on the left, and not on the right. In 134 autopsies below the age of a fortnight, I found the sigmoid flexure on the left side in 114; in 50 cases of Littre's operation which I have collected, the operator always met with the sigmoid flexure on the left side: in 30 post-mortem examinations of infants operated on for imperforation, the intestine was always found on the left; in 100 examinations of new-born children, Curling found the sigmoid flexure on the left side 85 times, and Bourcart, who made prolonged researches in order to elucidate this question, found the sigmoid flexure in its normal position 117 times out of 150.'

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* Mr. Curling practised both operations on the bodies of 20 infants who had attained the full period. Colotomy in the left groin was easy in 18 cases; in the other 2 the bowel curved over to the right side, so that to open it the incision must have been in the right groin. Colotomy in the left loin was easy in 8 of these subjects; difficult in 6; and impossible, without wounding the peritonæum, in the other 6. Curling, *Diseases of the Rectum*, 3d ed. pp. 222, 223.

† On the question of wounds of the peritonæum in operations, see the essay on INJURIES OF THE ABDOMEN, vol. ii. p. 672.

‡ Debout, in *Bull. de Thér.* tom. xlix. p. 116.

§ Rochard, *Bulletin de l'Acad. imp. de Méd. an* 1859.

‖ *Ann. Journ. of Obstetrics*, May 1, 1870.

¶ *Nouveau Dictionnaire de Méd. et Chir. prat.* tom. ii. p. 633.

** Curling, op. cit. p. 229. Rochard, op. cit.

†† Op. cit. p. 226.

‡‡ *Bulletin de l'Acad. imp. de Méd.* tom. xxiv. 1858–9, pp. 435, 445.

The incision in the right flank has indeed this recommendation, that should the large intestine be altogether absent, a lower part of the remaining intestinal tube will more probably be reached on the right side than on the left. Such a malformation, however, must be very rare; and the infant would, I should suppose, be hardly viable.†

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* *Leçons cliniques*, p. 121. M. Giraldès refers here to two cases in which, in performing Littre's operation, he came upon an undescended testicle.

† In one curious case, recorded in the *Path. Soc. Trans.* vol. xii. p. 87, there was a kind of transposition of the large intestine, the iliocæcal valve being in the left instead of the right iliac fossa, and the transverse arch of the colon passing from left to right, and terminating in a very large cul-de-sac in the right iliac region. There

On the whole it seems better to operate in the left groin. Whether after failing to find the sigmoid flexure in that part, it would be the better course to make an artificial anus in the small intestine, or to perform a second operation in the opposite groin, must be left to the discretion of the operator. Neither course would have much prospect of success; but if the infant were healthy and strong, the latter might be justifiable.

In the *Bull. de l'Acad. de Méd.* tom. xxiv. 1858–9, p. 434, Velpeau gives the following advice. He operated on an infant with imperforate anus. Not being able to find the rectum by operation in the perinæum, he resorted to lumbar, and then to inguinal colotomy, but gives no particulars of the operations. On the death of the infant, the rectum was found complete, but empty, and deviated to the right. He therefore advises that, after having opened the gut in the loins or groin, a probe should be passed down to ascertain whether the lower part of the gut is not present, and whether it may not be possible to establish the natural anus.

Imperforation of the small intestine.—Two cases of congenital obstruction of the lower part of the small intestine have been communicated by M. Depaul to the *Acad. imp. de Méd.*, in which the diagnosis was successfully established; the following being the symptoms principally relied on. There were the usual symptoms of obstruction—the abdomen was swollen, the anus and rectum were natural, clysters would pass, but soon returned without meconium;* a flexible tube could be introduced for a considerable distance, but brought away no fæces; rather seemed to cause vomiting, the vomit being mixed with lumps of meconium. In a case of this sort auscultation and percussion would yield indispensable data. Littre's operation, at the point indicated by the part at which the intestinal resonance seems to stop (especially if the fluid injected can be heard to stop near the same point), appears the appropriate treatment, though little hope can be entertained of good from anything.

Malformations of the umbilicus.—Another affection, probably due to congenital malformation, is that warty or nipple-like tumour projecting from the umbilicus, which is tolerably often seen in children, and seems due to some morbid condition left by the separation of the umbilical cord. Mr. Athol Johnstone, to whom we appear to owe our first accurate description of the disease in the English language,† speaks of it as 'a stout nipple-shaped papilla or tubercle, rising from the centre of the main umbilical depression;' and says that he has seen it attain the height and circumference of an inch. I have had several cases, but none of this size. Mr. Cooper Forster and Mr. Bryant also speak of this affection. In most cases the tumour is solid, in some a minute canal extends along it for a short (but only a short) distance. No water flows along this little canal, nor does the canal lead into the bladder. The treatment of these cases is exceedingly simple; a ligature tightly applied being all that is necessary.

Umbilical fistulæ.—There are other though less common cases in which the

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were also in that case other malformations, not, however, apparently inconsistent with life. An exploratory incision from the perinæum having failed, nothing further was done. In this case, had the course which I should have been inclined to pursue been followed, the cæcum would probably have been opened; but this is, I should suppose, a unique case.

* I once saw a case of the kind in which the diagnosis was rendered erroneous by the fact that we could not pass any large quantity of injection. In fact, it returned almost instantly. After death, however, the obstruction was found quite high in the small intestine. The fullness of the abdomen and the straining of the abdominal muscles were the only causes which I could conjecture for the obstacle to the passage of the injection.

† *Lectures on the Surgery of Childhood*, 1860, p. 44. The affection is said to have been first pointed out by Dugès, *Dict. de Méd.* en 15 tomes, t. xii. p. 159.

urachus remains open [*] and the urine is discharged from the navel; or in which there is a fæcal fistula, congenital or acquired; [†] or in which there is a biliary fistula at the navel.[‡] These cases must be distinguished from the foregoing trivial affection, as can readily be done by the character of the discharge.

The cure of such fistulæ should be attempted, but with caution. The actual or potential cautery applied to their edges can do no harm. It has, however failed in all the cases that I am acquainted with, and then a plastic operation ought to be attempted. But I cannot encourage the reader to be very sanguine of success by this method either. In the two cases related by Mr. Cooper Forster such an operation was performed; but it does not appear to have succeeded in either. Mr. Bryant's case was not made the subject of any treatment. In mine the treatment by cautery failed, and I lost sight of the child before performing the plastic operation which I contemplated.

A very singular case, the result of malformation of the umbilicus, was sent to me a year or two ago by Dr. Harland Whiteman, of Putney.

The infant was a male prematurely born, and on its birth the funis was noticed to be bifurcated, and it appeared to Dr. Whiteman as though one bifurcation contained the arteries, and the other the vein. This bifurcation commenced about three inches from the umbilicus, and the part of the cord attached to the belly was marked by a rather thick gelatinous septum. The funis was tied and divided below the bifurcation. Nothing was noticed as being wrong for a fortnight. The nurse was observed to be unwilling to be seen when engaged in dressing the cord, but always replied that 'all was going on right,' until, at the age of about fourteen days, Dr. Whiteman was again summoned on account of a bad smell from the navel, and the nurse having reported that there was something wrong about it. On examination, it was seen that inflammation and ulceration extended to some distance around the umbilicus, and there was also sloughing still going on of the septum and of what remained of the right bifurcation. This bifurcation contained no intestine. The sloughing portion was included in a ligature. The opposite bifurcation (on the infant's left) contained intestine; there was a deep sulcus or fissure at the bottom of it, close to the umbilicus, out of which an offensive fæcal discharge continually exuded. Some fæces, however, still passed by the anus; but this ceased as the gut protruded out of the navel, and its whole circumference gradually became ulcerated, so that the intestine was divided into two parts at the time that I saw the child. There was then a large coil of intestine hanging out of the belly, and partly everted, the fæces exuding from its open mouth. Another smaller coil, which transmitted no fæces, lay on its right side, separated from it by a slight depression or septum, apparently, as I thought, a part of the mesentery.

It appeared evident that there had been some defect in the closure of the umbilical aperture, probably dependent on the fissured condition of the cord, and that into one of these fissures a herniated portion of the gut had protruded.

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[*] In the *Med.-Chir. Trans.* vol. xxxiii. p. 293, there is a case reported by Mr. Paget, of Leicester, of patent urachus, in which the patient, a man æt. 40, laboured under symptoms of stone. The unnatural opening was of large size, an inch in diameter; notwithstanding which he could retain about a pint of water, and only a little escaped in micturition. There was also hernia at the opening. The calculus had formed on a hair, which had probably slipped down accidentally from the pubes. It was extracted by passing the finger down the patent urachus. No operation was attempted on the patent urachus. See also Bryant, op. cit. p. 144.

[†] Cooper Forster, *Surgical Diseases of Children*, p. 107.

[‡] I have seen no published case of this affection; but a boy, æt. 10, was under my care in the year 1862, on account of a discharge of pure bile from the umbilicus. This was said to have followed the removal of one of the warty tumours above described. The fluid responded to the usual tests for bile, and, as well as could be ascertained, was free from any fæcal admixture. The sinus from which this fluid exuded was so minute that I could form no idea of its direction, but it seemed to extend a considerable distance.

The ulceration of the intestine, and its ultimate division into two parts, were equally evidently the result of mechanical violence, which could not have been applied at the point where Dr. Whiteman tied the cord, even if it were possible (which, of course, it could not be) to overlook a protrusion of more than three inches of small intestine, or to tie it without producing any symptoms for several days. It appeared, therefore, more than probable—in fact, nearly certain—that the nurse, ignorant of Dr. Whiteman's reason for leaving so large a part of the cord, had at a later period applied another ligature close to the umbilicus, to hasten its separation, and had unwittingly injured the intestine, which by this time had protruded.

When I saw the infant, its death, if unrelieved, was certain, as the protrusion kept increasing. There was, indeed, nothing to oppose its increase when the child cried or coughed. I was unwilling to abandon it to death without treatment, and the only courses which seemed open were, to endeavour to press back the gut by pad and bandage, or by some plastic proceeding to endeavour to divert the fæces from the surface of the body to the lower coil of the intestine. The former plan, I thought, must necessarily prove fatal, as pressure applied on an everted mucous surface constantly covered by fæces must be ineffectual in repressing the gut, and at the same time productive of great irritation, and probably of sloughing. I determined, therefore, to attempt Dupuytren's method of treating artificial anus. The two adjacent portions of intestine were accordingly brought into apposition along their serous surface by means of the entérotome, and the blades of the latter instrument were gradually tightened upon them. This plan promised at first to be successful; the intestine was repressed into the belly by the instrument, and on the third day after its application fæces began to pass from the anus. The motions continued to pass entirely per anum for four days, by which time the entérotome was separated, when, unfortunately, in a fit of coughing, the gut reprotruded, the adhesions which had united its two coils having given way, and the protruding portion became larger than it was before the operation. I reapplied the instrument; but the child rapidly sank, and died in a day or two. On post-mortem examination, the bowels were found smeared with a thin layer of pus; no other noticeable morbid appearances were present. The two divided portions of the small intestine lay in close apposition. The preparation is in St. George's Hospital Museum, Ser. ix. No. 103*a*.

With this case may be compared one figured in *Path. Soc. Trans.* vii. 216, and in which a pendulous triangular pouch hung out of the umbilical aperture, lying above the cord, and having an umbilical hernia at its base. The pouch terminated in two horns, each of which was perforated by an opening; and from each of these openings meconium passed. Meconium also passed from the anus. The pouch is represented as having consisted of an *inversion* of the bowel, one horn of the pouch being the ileum, and the other the cæcum. But as the passage was uninterrupted to the anus, and as both horns, though quite unconnected with each other, transmitted the meconium, it seems evident that the pouch must have been more in the nature of a diverticulum than of a prolapsed and inverted bowel. If the small intestine had protruded from the belly through some sloughy aperture, and its coats had become everted, so that the mucous coat presented externally, and the tube was exposed and transmitted meconium, it is clear that all the contents of the intestine would pass that way, and none could come either by the anus or by any lower portion of the intestine, which might be similarly prolapsed.

Hermaphroditism.—Most of the malformations of the genito-urinary organs have been treated of in former pages of this work: the malformations of the male urethra, producing hypospadias and epispadias, at vol. iv. p. 939; those of the penis which accompany extroversion of the bladder, at p. 881 of the same vol.; those of the vagina and uterus, at p. 3 of this volume; and those of the testes, at p. 71, et sqq. There remains, however, the question of doubtful sex from malformation of the external organs, which is often brought to the surgeon to decide, and, as it seems, is often decided wrongly. The male organs may simulate the female in this way: the corpus spongiosum and the corresponding portion of the urethra are absent; the penis is small and the prepuce imperfectly formed, resembling a large clitoris; the scrotum is split, leaving a gap which represents the vagina; its two halves form cutaneo-adipose folds, representing the labia majora, between which is the orifice of the short urethra; and the resemblance may be completed by the testes being retained in the abdomen. The female organs may simulate the male by a great enlargement of the clitoris, causing it to resemble the penis, the presence of the ovaries in the labia,* and a very small vaginal orifice like the opening in hypospadias. The majority of cases of spurious hermaphroditism in the female present, however, merely the enlarged condition of the clitoris, and may be recognised for females with tolerable ease, by passing a sound up the urethra into the bladder, and examining by the rectum. The presence of a uterus and vagina between the finger and the sound will then be evident. Even in the rare cases where the ovaries may have descended into the labia, on one or both sides, this method of examination may yet clear up the matter; and if the vaginal opening be large enough to admit the finger, no doubt need exist. The question is often more puzzling in cases which are probably males, with cleft scrotum; as is evidenced by the case quoted by Sir J. Simpson † from Otto, where an individual had lived ten years as a wife with three different men, who was yet afterwards affirmed by the Royal Medical College of Silesia to be a male. At the Pathological Society a short time since, a specimen was exhibited which elicited opposite opinions from very good authorities. Nor is it impossible that true hermaphroditism may in some cases exist—that is to say, that some parts of the male and female organs may coexist; as in the case of the sheep, described by Mr. Savory in *Med.-Chir. Trans.* vol. xlii., where, along with testes and other male organs, there was found a very perfect uterus and vagina. Also in the *Pathological Transactions*, vol. xi. p. 158, is the account of the dissection of the generative organs from a person regarded (and apparently correctly) as a female, but where a body much resembling a prostate was found; the urethra had the long course of the male, and the vagina could hardly be demonstrated. Some other cases will be found recorded by Sir J. Simpson.‡ Leaving aside, however, a few rare cases in which some doubt may exist, the careful examination of the folds simulating labia may detect a testis and cord (or a cord with rudimentary testis) on one side or both; or the proximity of the urethra to the rectum, with the development of the perinæum, may prove the sex to be male; or the direct continuity of the supposed vaginal canal with the bladder may show that it is really a male urethra. Occasionally it is said that extroversion of the male bladder has been mistaken for the vulva, or that an adhesion of the penis to the scrotum has caused a doubt of the sex of the child. Such conditions, however, can hardly deceive one who is prepared for their occurrence.

In the few cases where the above tests give only uncertain results, a doubt must be allowed to rest on the sex of the child, which perhaps will be cleared up by the development of the breasts and the propensities displayed at puberty; or which may remain until dissection clears up the difficulty. In all cases of true hermaphroditism the sex would be settled by the intrinsic organs (testes or ovaries) which are found on dissection. When doubt exists as to the sex of a child, it appears more prudent to bring it up as a male than to expose it to the disgusting and disappointing consequences of an attempted marriage.§

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* This is not so very uncommon. A case was laid before the Royal Medical and Chirurgical Society where Sir W. Lawrence, operating for strangulated inguinal hernia in the female, found the ovary in the sac. Mr. Pott's case is also well known.

† *Cycl. of Anat. and Phys.* art. 'Hermaphroditism,' the standard reference on this subject.

‡ See also a case by Rokitansky. *Centralblatt f. die med. Wissenschaften*, Berlin. Quoted by Larcher, op. cit. p. 284.

§ Mons. Ad. Richard asserted some time since that all hermaphrodites are really

It is but rarely that operative interference is justifiable in cases of hermaphroditism, and the operation consists always, as far as I am aware, in an attempt to enlarge the vaginal opening, so as to permit of sexual intercourse. A case of the kind under M. Huguier's care, in which the proceeding appears to have been successful, is recorded by M. Léon le Fort.*

I am not aware that any plastic operation has hitherto been attempted on hermaphrodite males; nor is there either the same motive or the same prospect of success, for the organs are probably too imperfect to be capable either of penetration or emission.

Malformation of skin.—The congenital † vascular tumours, or nævi, have been noticed above, with respect to their surgical treatment (TUMOURS, vol. i. p. 541). But besides these tumours there are other malformations, which consist chiefly in a mere discoloration, often accompanied by a development of hair. Of the more extensive discolorations (which are more common on the face than elsewhere), the common 'port-wine stain' is the most familiar example; and of those attended with development of hair, the ordinary mole. But there are rarer deformities of each kind, or involving a mixture of both kinds. Mr. Athol Johnstone informed me that he was consulted on account of a fine healthy baby, with an irregular dark-brown (almost black) streak extending across the root of the nose and invading the inner extremities of the eyelids on each side. The skin was thickened, and irregularly wrinkled and slightly elevated, and its surface was covered with short dark hairs. In this case the extent of the disease forbade any endeavour to extirpate it, which, however, in such affections it is particularly desirable to do if possible, both as a matter of appearance and from the undoubted liability of moles to become the seat of epithelioma. In the case of extensive maculæ no treatment seems to have any effect. In those less extensive, the skin may be destroyed by some powerful caustic, and thus the less disagreeable deformity of a white scar substituted for the stain. It might be possible perhaps to tattoo some of those maculæ with some substance which should produce a white colour, and the suggestion has, I believe, been made, but I am not aware that it has been followed. The plan could hardly, I should think, be practically useful, except in maculæ sufficiently small for extirpation with the knife or caustic.

Malformations of limbs.—The malformations resulting from congenital dislocation and fracture will be found described in the next section, by Mr. Brodhurst. Of other malformations of the limbs it seems hardly necessary to say much. Some of them do not admit of any treatment, and are only interesting in an anatomical and physiological point of view, such as the specimens of entire absence of bones and limbs; ‡ while in others the only question is whether the patient would be more comfortable with or without amputation. In the upper extremity the chief question will be as to the power of motion and prehension in the malformed hand, or claw, as the case may be; in the lower, as to the feasibility of adapting a stump to the part before or after amputation. It is

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males, however much the genital organs may approach the female type. *Union méd.* tom. iii. p. 543. Paris, 1859.

* *Vices de Conformation de l'Utérus et du Vagin*, p. 203. See also Larcher's translation of my work on the *Surgical Treatment of Children's Diseases*, pp. 270 et. sqq., where several very interesting cases of hermaphroditism of various kinds are collected.

† It might be worth while to remind the reader, in passing, that though probably all nævi owe their origin to some congenital condition, yet they are often, perhaps usually, not noticed till a short time after birth.

‡ For an extreme example, see a case figured in *Path. Soc. Trans.* vol. x. p. 308, where all four limbs were entirely absent; and the child (who had attained the age of five and a half, and was healthy and intelligent) consisted of a head, neck, and trunk only. Most of the leading forms of these general malformations of the limbs are figured in M. Larcher's work, already referred to; where will also be found drawings of the instruments which have been adapted to such patients.

therefore but rarely that amputation would be recommended in the upper limb, while in the lower it is often, if not usually, advisable.*

There are other deformities which may be produced by the pressure of the fœtal cord in utero, and in which, though the limb has not been amputated, it is distorted in various directions, and deep grooves are marked upon it, where the muscles appear to have become atrophied.† If any treatment can be available in these cases, it must be directed to bringing the limbs gradually into natural position by pressure appropriately directed, and by passive motion, and at the same time stimulating the muscles by friction, liniments, &c.

Polydactylism.—The most frequent malformation about the limbs, and one of the most common in surgical practice, is what is called polydactylism; that is to say, supernumerary fingers and toes. Instances in which a more or less perfect additional thumb exists are very often seen in our hospitals; and numerous examples prove that the defect is often hereditary. It is advisable to remove supernumerary thumbs or fingers early, since they are only in the way; but in doing so some little care is required, as the supernumerary digit often shares in the articulation of the natural one to its metacarpal bone; so that if the whole of the last phalanx of the supernumerary digit were removed, the natural joint would be laid open, and ankylosis might result, which would leave the finger or thumb stiff and extended; therefore the part must be carefully examined, and if even a doubt exists, the phalanx should not be entirely removed, but, flaps having been cut long enough to cover it, it should be divided with bone-nippers near its articulation. No deformity will be perceptible when the child grows up, as the little piece of phalanx left behind will not grow, but will be buried in the soft parts when the hand has attained its full size.‡

Supernumerary digits, which are seated upon perfect metatarsal bones, are also often attached to supernumerary bones in the tarsus itself; while others are attached to bifurcated extremities of a single metatarsal bone. In some cases the superfluous finger or toe is attached by a thin fold of skin to the continuity of the natural digit, quite away from the joint. In these cases the superfluous digit is rudimentary.

Two cases at least have been put on record in which a double hand existed: one by Mr. Murray of Brighton, in the *Med.-Chir. Trans.* xlvi. 29; the other by M. Giraldès, in his *Leçons cliniques sur les Maladies chirurgicales des Enfants*, p. 42. In both cases the bifidity appears to have commenced at the carpus, and in both the thumbs were absent. In Mr. Murray's case no operation was performed, the patient (who was a washerwoman) having been first seen at the age of thirty-eight. In M. Giraldès's case the superfluous fingers seem to have been removed (M. Giraldès merely says, 'en 1864 j'ai opéré un enfant qui avait les deux mains réunies en une seule'). M. Giraldès, however, agrees that the operation was unnecessary, since in this case, as well as in Mr. Murray's, all the eight fingers were movable, and the two parts of which the hand consisted could be firmly opposed to each other, forming a very useful member.

In the foot, supernumerary digits are matters of less consequence than in the hand. If there be but one, and that not sufficiently prominent to cause inconvenience in wearing the shoe, or an unsightly breadth of the foot, there can be little motive for interference. Mr. Athol Johnstone has recorded a case in which the remarkable number of nine toes, more or less perfect, were found on one foot; and the reader who is curious in this matter will find there a full account of the dissection of the part after removal.§

Webbed fingers is another very common deformity; and (unlike supernumerary digits) it usually occurs symmetrically on the two hands. It is most common between the last two fingers. The same condition is also found in the toes;

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* See a case and drawing by Mr. Lonsdale, *Path. Soc. Trans.* vol. iii. p. 464.

† See a case by Dr. Little, *ibid.* vol. i. p. 331.

‡ See also on this point Sedillot. *Note sur l'amputation des doigts surnuméraires. Comptes-rendus des séances de la Soc. de Biologie*, sér. 1, tom. v. ann. 1853, p. 145.

§ *Path. Soc. Trans.* vol. ix. p. 274.

but is a matter of no consequence whatever there. In the hand it appears to be exceedingly desirable to remedy this condition if possible; not merely on account of the use of the fingers, but also as a matter of appearance. The webbed fingers often enjoy a large share of usefulness; and the person can soon accommodate himself to his circumstances; but every visible variation from natural conformation is a source of annoyance and hindrance to a child, and should by all means be remedied if it can be done without danger. Of course nothing is more easy than to cut the fingers apart: the difficulty which is experienced is in preventing their growing together again. Various plans have been adopted. The band having been divided completely down to the cleft, the edges of the wound may be brought together down to the apex of the incision, in order to procure union by the first intention. If the edges will not of themselves come together without force, a portion of skin may be transplanted so as to fill up the cleft; for it is in the cleft that the tendency to cicatrisation is manifested.

I would on this head call the reader's attention to the following very ingenious operation, reported by Mr. Barwell in the *Medical Press and Circular*, April 25, 1866, in a case of webbed fingers—the index, middle, and ring on the left hand—which had already been twice operated on by the usual methods without success.

'I thrust a straight bistoury in a sloping direction from behind forwards through the tissues uniting the index and middle fingers, keeping the blade much closer to the latter, so that, when the whole length of the digits had been separated, so much tissue was left on the forefinger that its edges could be brought neatly together and sewn with wire. The same proceeding was then used at the next interspace, the greater amount of skin being left and sewn round the inner side of the middle finger. Thus, the wounds to be filled up lay on the outer side of both middle and ring fingers, and at the fork or point of their bifurcation. Of these wounds an impress was taken on a piece of paper, and the necessary pieces were cut from the haunch in such wise as to leave a portion of skin between the two excavations, and also so as to enable me to lift up each strip-like piece in a loop while it remained attached at either end. The wound in the buttock was closed with silver-wire, the fingers to be covered were thrust through their respective loops, and first the palmar edge was stitched —a process which required much care and ingenuity—then the dorsal aspect was secured, and afterwards the hand and arm were carefully bound *in situ*.

'The child slept well during the first two nights, on the third pain kept her restless, and on the fourth day I removed the bandage and cut away the skin connections with the haunch. The hand had swollen from position, but only a very small part of the implanted skin had died, the rest was fairly united. It is unnecessary to follow the details of the case further; it did uninterruptedly well, and in a month the hand was healed, and passive motion had begun to render the fingers more mobile.'

Another plan is to divide the fingers from each other, and leave the wound to granulate, care being taken to press something like a band of string or metal into the cleft, in order to prevent adhesion there; the foreign body being fastened to a bracelet. Or, which seems the most promising plan, a large metal ring may first be passed through a hole made at the cleft, and worn there like an earring till the sides of the hole have cicatrised. After the posterior angle of the wound is thus secured against the formation of adhesions, some one or other of the above plans may be adopted with better prospect of complete success. But even if the adhesions do form to some extent, and so render the fold between the fingers deeper than natural, this is a much less conspicuous defect than the former, and besides is not irremediable by further operation.

M. Giraldès has succeeded in dividing these webs by means of a kind of entérotome applied to the web, and gradually tightened, so as to destroy the web in about a week. An instance of the use of this method will be found in Giraldès' *Maladies chir. des Enfans*, p. 507.*

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* On the subject of webbed fingers, and all the other deformities, congenital or acquired, of the fingers, I cannot do better than refer the reader to M. Fort's *thèse de concours*, '*Des Difformités congénitales et acquises des Doigts*,' Paris, 1869.

Hypertrophy of the limbs occurs, as far as I can judge from the limited number of cases which I have seen and met with in books, from two causes, viz. from disease of the vessels, or from a congenital tendency much allied to, if not identical with, that which produces the more limited and striking hypertrophies spoken of below as 'congenital tumours.' In the former class of cases the diseased action results in changes analogous to those produced by chronic inflammation, and similar to those which follow chronic inflammation (though only rarely) in the long bones. Thus I have seen in a case of diffused venous nævus (or rather diffused enlargement of all the vessels of the limb, including the veins), the whole leg become larger, harder, hotter, and longer than its fellow, as it is occasionally noticed that the tibia, in chronic inflammation, outgrows its healthy fellow.*

The hypertrophy may affect the whole limb, or only a portion of its length (always, I believe, the lower part), or a part only of the foot or hand, or, finally, only one or more digits.

I do not wish here to speak of the hypertrophy which is an occasional, though very rare, symptom of extensive disease of the blood-vessels, but only of the truly congenital hypertrophies. These depend upon no known cause; † and although some of them have been found to be complicated with hypertrophy of the walls of the veins, the latter can have no causal relation to the affection. The congenital hypertrophies may be divided into the symmetrical and the unsymmetrical.‡ In the former, all the parts of the limb are in due proportion; so that there is nothing unnatural about it beyond its gigantic size. In the latter, the parts are variously deformed by large fatty excrescences, and by over-development of the joint-ends of bones, leading to unnatural position or dislocation of one or more joints. Prof. Busch believes that this unnatural condition of the joint-ends is connected with some morbid growth of the epiphysial cartilage. It leads to irregular enlargement of the articular ends, something like what is seen in rheumatic arthritis; but such enlargement is no necessary accompaniment of overgrowth of the bones. Busch himself has figured (p. 185) the skeleton of a foot in which the bones of the three middle toes are greatly elongated, but all the portions of the elongated bones are in perfect proportion.

The temperature of hypertrophied limbs varies in different instances. In most cases it is normal; in two referred to by Busch it seems to have been diminished,§ and in one only increased.

The simple hypertrophy of the cellular and adispose tissues of a limb does not necessarily include any change in the muscular or bony framework. It is strikingly like the ill-defined hypertrophy which often accompanies and surrounds congenital tumour.

The annexed figure was drawn from a case of the kind. The patient was a child eight months old, in whom the left foot and leg, nearly as high as the knee, were larger than the opposite, and in whom the enlargement of the foot was so inconvenient that, as it was on the increase, the foot was amputated. Anatomical examination showed that the increase in bulk was due only to an unusual deposition of fat and cellular tissue, the muscles as well as the bones being normal.

The amputation of the foot, in this instance, still left the leg considerably larger than its fellow; but when I last saw the child, the limb was steadily diminishing in size under the influence of pressure. I believe that the amputation had been performed under the idea that the disease was of a malignant nature; but the congenital history and the uniform enlargement are symptoms which sufficiently mark the nature of the disease, and exclude all probability of cancer.

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* See Diseases of the Bones, vol. iii. p. 737.

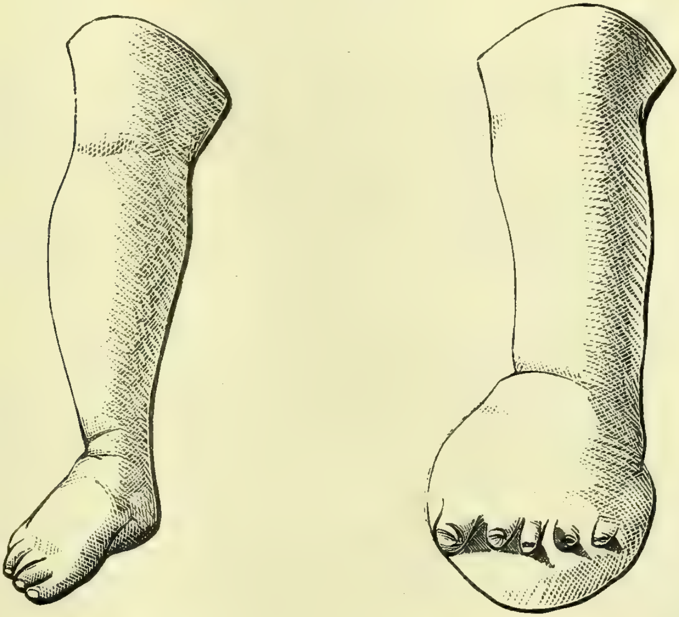
† It may be remarked that only in a very few of these cases has any hereditary predisposition been traced.

‡ I would refer the reader to Busch in Langenbeck's *Archiv*, vol. vii. p. 174, for a very full account of this subject.

§ Mr. Curling's case in *Med.-Chir. Trans.* vol. xxviii. p. 337, and Wuiff's in *Petersburger Med. Zeitschr.* 1861, 10. Heft.

Treatment.—In cases where the limb is increased in length as well as in bulk, nothing of course can be done beyond the use of a high sole on the normal foot, unless amputation is thought to be indicated; but where the increase is only in bulk, and is due chiefly (or, as far as can be ascertained, solely) to the enlargement of the cellulo-adipose tissue, much good may be anticipated from carefully-regulated pressure. I have seen a case in which the use of an elastic stocking much diminished the size of the limb; in fact, without it the boy could hardly move about freely: and in the case here represented, where amputation of the foot was performed, the benefit derived from strapping the leg was very marked. As to amputation, I own that I should long hesitate before resorting to so extreme a measure. We know that congenital tumours sometimes disappear spontaneously—why not congenital hypertrophies? especially if assisted by judicious pressure. Besides, the affection is in no degree dangerous to life; nor does it make any very perceptible impression on the general health. And, although a child's gait is awkward with an unnaturally heavy and cumbrous limb, it is, after all, as good as with a wooden leg. As to internal remedies, the liquor potassæ may be tried; but I should not expect much from its use. I should not be indisposed, in a case such as that figured above, to try the effect of tying the main artery of the limb.

FIG. 413.



[Hypertrophy of the foot and leg. From casts in St. George's Hospital Museum, representing the two legs of a child, in whom the foot was amputated on account of hypertrophy affecting the subcutaneous and adipose structures.]

When the hypertrophy affects only one or more of the fingers or toes, the question of amputation presents itself in a different point of view. In the foot it is usually advisable to remove the hypertrophied toes as early as possible. In the hand, the surgeon must carefully consider whether the member will be more useful with its gigantic fingers or without them.

In the unsymmetrical hypertrophy, on the other hand, amputation is, as a rule, advisable in the early stage of the disease. As the limb grows, distortion and deformity will surely increase. And when the malformation is complicated by the formation of large cellulo-adipose tumours, or lipomata, on the hypertrophied parts, the operation is still more urgently indicated.

The malformations resulting from the absence of bones or other parts are in the province rather of the instrument-maker than the surgeon. All that can be done is, by some arrangement of splints and india-rubber bands, to replace the parts wanted, as far as can be; and this is hardly possible in infancy.

T. HOLMES.

Congenital dislocations.—Certain dislocations are found at birth and are therefore termed congenital. These luxations occur especially at the hip-joint. Other joints also are affected, however; such as the knee, the wrist, the shoulder, the elbow, and the jaw. The last-mentioned dislocations are always connected with monstrosity, paralysis, or alteration of the articular surfaces, and they are more frequently sub-luxations than true dislocations.

Together with anomalies of organisation every form of congenital dislocation may be found; and also without monstrosity some irregularities of position occur which are sometimes treated of as dislocations, but which are slight displacements through paralysis or muscular retraction. Such are congenital dislocations of the shoulder.

These are not true dislocations, but partial displacements with paralysis, approximating more or less in appearance to true dislocations; they are perfectly reducible, and are induced through injury at birth. The example which was adduced by M. Gaillard was probably of this description. The title under which the case is given runs thus: '*Observation de luxation congénitale de l'humérus, réduite au bout de seize ans.*' * Bouvier, who had to report on it, considered that the dislocation was not truly congenital; but the result, he said, was extremely remarkable, the dislocation having existed for fifteen or sixteen years.†

It cannot be doubted, on reading the case as given by Gaillard, that this lesion was not a true dislocation, but that the displacement was due in the first instance to paralysis, and that it was subsequently somewhat increased through muscular retraction. The removal of such forms of paralysis and consequent displacement is not so rare that a single fact of this nature should have been thought worthy of a place in the *Mémoires de l'Académie royale de Médecine.*

Congenital dislocations of the knee are sub-luxations, which require to be treated as contractions, namely, by extension of the limb after subcutaneous section of the ham-string tendons.

Excessive flexion of the wrist and elbow are by some understood as dislocations. These positions are due, however, to muscular retraction alone. Congenital dislocations of these joints are always connected with malformation or monstrosity.

An instance of congenital dislocation of the jaw is recorded by R. W. Smith.‡ The individual was idiotic, however.

Without further preface, then, dislocations of the head of the femur may be considered.

Congenital dislocations of the head of the femur occur in three directions; namely, upwards and outwards, directly upwards, and upwards and forwards. The first-mentioned variety, or that upwards and outwards, alone demands attention; the other two forms of dislocation having only been seen in fœtal monstrosities.

Dislocation of the head of the femur upwards and outwards, on to the dorsum of the ilium, occurs for the most part as a double luxation, both sides of the body being affected; and it occurs much more frequently in the female than in the male. Thus of twenty-six cases which were seen by Dupuytren in the course of twenty years, two or three only were single, and only four of these luxations occurred in males.* Of twenty cases which have come under the author's care, sixteen were double luxations, and thirteen of these occurred in females, while in one boy and three girls the dislocation was single.

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* *Mémoires de l'Académie royale de Médecine,* tom. ix. p. 702. 1841.

† *Bulletin de l'Académie royale de Médecine,* tom. v. p. 295.

‡ *A Treatise on Fractures, &c.* chap. ix. 1847.

This affection is supposed by some to be hereditary. The belief rests on the statement of Dupuytren,† which, however, is insufficiently supported.

The *causes* of this dislocation have excited considerable discussion, and various theories have been propounded in support of the different views which have been advanced. This subject has been considered especially by Palletta,‡ Dupuytren,§ Pravaz,‖ R. W. Smith,¶ Jules Guérin,** and Carnochan.††

Disease within the articulations of the fœtus is supposed by some to give rise to dislocation. Diseases of an inflammatory character occur in the fœtus, and among others, synovitis, both gouty and syphilitic. It cannot be doubted that, effusion taking place within the joint, dislocation might occur. Proof is wanting, however, that this has absolutely taken place; yet this view, which originated with Ambroise Paré, finds supporters in Sédillot, Malgaigne, Gerdy, Parise, and others.

Again, it has been thought by Breschet and others that arrest of development is the cause of these affections. But Cruveilhier tells us that he has found both the head of the femur and the cotyloid cavity progressing to their normal development in cases of this dislocation. He speaks of these luxations, however, as *vices de conformation*, and he represents in his first plate a full-grown fœtus, with club-hands and club-feet, and with congenital luxation of the heads of the thigh-bones, without testes and kidneys, and with other deficiencies. In this instance the ligamentum teres existed; the heads of the thigh-bones were flattened and deformed, and the cotyloid cavities were shallow.‡‡

Original defect in the organisation of the germ was the theory propounded by Dupuytren to explain these lesions; and he suggests that, considering the perfect health of these infants at birth, and the absence of disease, either past or present, of the head of the femur or in the cotyloid cavity, this hypothesis is necessary to account for the luxations. It receives no support, however, from physiological facts, nor from the consideration of the laws which govern the evolution of the embryo.

Carnochan supposes that 'a pathological spasmodic retraction of the muscular tissue, resulting from a perverted or disturbed condition of the excito-motor apparatus of the medulla spinalis,' gives rise to this displacement. He continues thus: 'Congenital displacements occurring at the ilio-femoral articulation result from active morbid muscular retraction; that morbid muscular retraction itself is to be traced to a morbid condition of the central ganglionic mass of the cord; and this pathological condition is either located in the ganglionic mass, or conveyed thither by the incident-excitor nervous influence of the excito-motor apparatus of the medulla spinalis.'

External violence has been thought to be a cause of congenital dislocation since the time of Hippocrates. It has been shown that external violence may occasion fracture in utero;§§ and Carnochan believes that it will produce fracture rather than dislocation.

Considering the position of the fœtus in utero—that the thighs are flexed upon the abdomen, and that the heads of the thigh-bones must therefore press upon the posterior and inferior portions of the capsule of the joint—it may be inferred that external violence, with or without spasmodic muscular action, might cause the head of the femur to pass from its shallow acetabulum.

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* *Leçons orales de Clinique chirurgicale*, tom. iii. art. 8.

† Op. cit. p. 217.

‡ *De Claudicatione Congenitâ.*

§ Op. cit.

‖ *De la Curabilité des Luxations.*

¶ *A Treatise on Fractures.*

** *Recherches sur les Luxations congénitales.*

†† *On Congenital Dislocations.*

‡‡ *Anatomie pathologique du Corps humain*, tom. i. p. 1.

§§ *Med.-Chir. Trans.* vol. xliii. art. 8.

Under these circumstances extension of the limb at birth alone is required to displace the bone upon the dorsum ilii—the external iliac fossa being the ultimate position of the head of the femur in congenital luxation. Again, violent or sudden traction at birth may doubtless induce this form of luxation; and it is probable that congenital luxations with perfect development of the head of the femur and the cotyloid cavity are thus produced, some impediment having occurred to delay the completion of the birth.

This dislocation never occurs except with a preternatural labour; and it occurs especially together with a presentation of the nates. When the breech presents, the child passes through the pelvis with the legs doubled up and the feet towards the thorax. The blunt-hook or the finger may be used to assist the passage of the child; and for this purpose it is inserted at the angle formed at the top of the thigh. But traction in this position necessarily increases the pressure of the head of the thigh-bone against the inferior and posterior portions of the capsule of the joint, and readily further displaces the femur and causes the head of the bone to escape from its shallow acetabulum.

The *symptoms* of this form of dislocation differ as the age at which the lesion is observed differs. At birth it passes unobserved. And, indeed, there is nothing to attract attention to the displacement: it is painless, or if not entirely painless, it is not observable, for the direction of the limb is not sensibly altered, and the motion of the head of the bone is free. Doubtless if the limb were examined with a view to dislocation, the displacement would be discovered.

When the child is lying down, the head of the femur is very slightly prominent; it may be distinctly felt, however, on rotating the limb. In the erect position the head of the bone becomes prominent, and presents visibly on the dorsum of the ilium above and behind the cotyloid cavity.

When the dislocation is double, the pelvis is rendered very oblique, the pubes being carried backwards and the sacrum being raised; the abdomen is prominent and the lumbar region is remarkably hollow—lordosis; while, for the sake of equilibrium, the shoulders and upper part of the trunk are thrown back. The trochanters project abnormally and approach nearer to the crests of the ilia than in their natural condition, and the heads of the thigh-bones can be seen projecting on the ilia beneath the glutei. These several points are well shown in the opposite woodcut.

The muscles of the lower extremities, from insufficient use, are small; the thighs have an inward direction, constituting in some cases genu valgum; while the feet are thrown somewhat outwards, and the sole of the foot is rendered flat—valgus.

The gait in double dislocation is most peculiar and unmistakable; no other motion is like that which is occasioned by this lesion: it is a rolling motion of the trunk together with double lameness; and yet it is painless and rapid.

When the head of the femur is dislocated on one side only, the limb is shortened, and the toes only are brought to the ground in walking, the heel being elevated. There is much lameness on the affected side, and the limb is smaller than the other. The obliquity of the pelvis is not so great as when the dislocation is double.

In the recumbent position the lumbar curve is effaced, and the thigh-bone may be drawn down and its head retained against the acetabulum. Shortening of the limb then disappears, and its general appearance becomes normal.

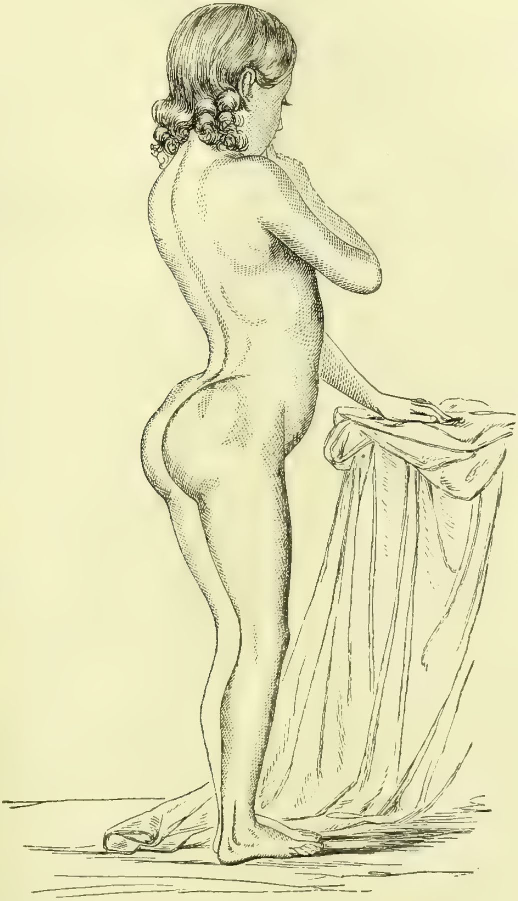
At birth the mobility of the limb is too great. As age advances, deformity increases, and at the same time the hope of restoration of the limb diminishes.

The morbid appearances which are met with in cases of this dislocation vary according to the age of the individual. As has been already explained, only one form of congenital luxation occurs, except with fœtal monstrosity, namely, dislocation upwards and outwards. Soon after birth the acetabulum is scarcely altered in shape and dimensions, and the head of the femur also retains its normal appearance. Changes, however, soon take place both of the head of the bone and in the cotyloid cavity, the cavity being filled up with cellulo-osseous material, and the head of the bone being flattened and rendered irregular in form, deprived of its articular cartilage, and atrophied.

The capsular ligament becomes elongated, but it may retain its integrity for many years. At length the head of the femur may escape through its capsule and come into direct contact with the ilium; and, the ligamentum teres being stretched, becomes slender, and finally it gives way.

When the head of the bone has passed through the capsule, a false articulation commences to be formed. Thickening of the cellular tissue with deposit of lymph takes place, which is ultimately developed into a new capsule; while a cavity is formed to receive the head of the bone by the deposition of osseous matter upon the ilium.

Fig. 414.



A typical case of congenital dislocation of both hips.

The *treatment* of this affection in its earliest stage is much more hopeful than is generally supposed.

When dislocation occurs without other abnormality, the acetabulum and the head of the bone are usually perfect at birth. There would then be neither difficulty in reducing the dislocation nor in retaining the head of the bone in the acetabulum. When, however, the dislocation is overlooked and its reduction is not undertaken until several months or years have elapsed, changes will probably have taken place which tend to impede the reduction, and which prevent the head of the bone being retained in the acetabulum. Absorption of the head of the bone proceeds at the same time that the acetabulum is being filled up; while the tissues around the head and neck of the femur are undergoing degeneration, those which are stretched undergoing fibrous degeneration, those which are relaxed becoming weak and fatty, and those which are much exerted, hypertrophied.

At birth the diagnosis can only present a certain difficulty when the luxation is double. When it is single this can scarcely occur; for the difference in the length of the limbs, and especially the difference which exists on the two sides of the pelvis, will discover the dislocation.

Generally, however, the dislocation is only discovered when the child begins to walk. Then the peculiar gait—the lameness when the dislocation is single, and the rolling movement of the trunk when both thigh bones are displaced, is certain to attract attention.

All the peculiarities of this dislocation are exaggerated when the patient is standing, and especially in walking; while, on the other hand, they are much diminished in the recumbent posture. It is for these reasons that congenital dislocation of the femur is seldom discovered until the child begins to walk alone: then the peculiar gait attracts attention.

There was lately under the author's care, in St. George's Hospital, a case of this description, in which the peculiarities of this dislocation were very strongly marked; for the boy was tall, and the trunk and upper limbs were largely developed. He was sixteen years of age.

In this instance both limbs were dislocated, and the trochanters projected abnormally and approached nearer to the crests of the ilia than in their normal condition. The pelvis was thus rendered very oblique, the abdomen protuberant, and the lumbar and lower dorsal vertebræ were curved forward in a remarkable manner. The heads of the thigh bones could be seen lying on the ilia and projecting beneath the glutei. In consequence of the position of the heads of the thigh bones in this as in all these cases, the knees are directed inwards and the feet become flat; and on account of the limited motion of the lower limbs, they remain weak, the muscles being insufficiently developed. While this is the invariable condition of the lower limbs in these cases, the muscles of the arms and of the upper part of the trunk become largely developed, for they are much used in progression; and in the instance to which I now refer they were like those of an athlete, and, as compared with the lower limbs, presented a remarkable contrast.

This boy was not admitted into the Hospital with a view to treatment, for those changes to which reference has already been made were to a great extent complete; but before this period has arrived and while the cartilaginous surfaces retain their integrity, the dislocation may be reduced, and the head of the bone retained in the acetabulum. It is probable that this may always be accomplished by manipulation under chloroform prior to that state of muscular retraction taking place which is at length the necessary result of displacement of the limb. When, however, muscular retraction has taken place, although the length of the limb may possibly be restored by drawing down the head of the femur to rest on the acetabulum, it is hopeless to endeavour to retain the head of the femur in the cotyloid cavity, without in the first instance dividing subcutaneously those muscles which tend to displace it. These muscles are those which are inserted into and about the trochanters, especially the glutei and the rotators. When these have been divided subcutaneously there is no further tendency to displacement of the head of the femur. This is the case even when a retentive apparatus is not immediately applied to the limb; but, after its application, subsequent displacement is most easily prevented. After a period of some weeks, consolidation takes place about the head of the bone, vhich tends to hinder displacement. Then passive motion may commence. It s necessary to continue the use of retentive apparatus for many months without essation.

As an example, a case may be cited in which this operation was performed n December 2, 1869, with Mr. Whaley, on a boy four years of age, whose right emur was dislocated. This child walked with help and a sustaining apparatus n the following May, and in June he was able to walk alone, and without the lightest displacement of the head of the femur taking place.

Fractures in utero.—Intra-uterine fractures of the long bones are rare. They ccur, however, both as simple and compound fractures. Montgomery has laced on record the following instance: 'I saw,' he says, 'a woman, eight nonths pregnant, fall (from a window) twenty-five feet, into the stony street, on er face. Her hip-joint was dislocated, and her face and hands were cut; ut the uterus was not ruptured. She was delivered that night of a dead child, vhich had some of its bones broken, and which had sustained several other njuries. She recovered perfectly.' *

Fractures of the fœtal skull have been frequently observed: numerous cases re on record. These are for the most part incomplete fractures, where the one becomes bent; and they are produced by the pressure to which the head s subjected in its passage through the pelvis; or they are occasioned by the nechanical force of the forceps of the accoucheur.

There is also another class of cases which has attracted considerable attention, nd which is mentioned by authors under this title of intra-uterine fractures—olutions of continuity, namely, occurring in a cartilaginous or very imperfectly ssified skeleton. This condition is, however, now known as congenital rickets; nd it is a condition differing so widely from that of fractures in utero, that it vill only be necessary to allude to it. Grätzer, Mansfeld, Amand, Barker, haussier, D'Outrepont, and some others, have directed attention to these olutions of continuity.

Among fractures in utero, those cases which offer the most interest are ractures of the long bones, whether simple or compound, in which reunion more r less complete is observed at birth; or where other proof exists of the fracture aving taken place prior to the commencement of parturition; fractures, conequently, not only occurring in utero, but which have not been produced by nanipulations of whatever kind during the period of parturition. Such cases re recorded by Ploucquet, Kopp, Devergie, Carus, Schubert, Sachse, and Moffat. For the cases themselves, I must refer to the *Medico-Chirurgical Transactions*, vol. xliii. 1860, art. 8. In one instance, the fractured extremity f the bone appeared in the wound; the periosteum was destroyed, and the ips of the wound were pale and flabby. In another, the bone protruded fully n inch, and it was carious. In a third case, the uterus was wounded, and lood escaped per vaginam. The fracture had reunited at birth, and the leg vas one inch and three-fourths shorter than the other. The following outlines f cases, which I saw together with Dr. Gream and with Mr. Gardner (which re also related in the paper above alluded to), are not without interest.

In the first case, it was observed, at birth, that there was considerable swelling about the right knee, which at length terminated in abscess. There was lso a second swelling at the upper part of the thigh; but this subsided vithout breaking. At the knee, however, it was found, as the swelling ubsided, that an abnormal condition of the bone existed. The leg could only e partially flexed, and it could not be fully extended. The extremity was oth shorter and smaller than the other.

It appeared in this instance that there had been a fracture through the piphysis by which the inner condyle of the femur was broken off. The condyle rojected in front of the shaft of the femur, and it had been rotated outwards.

In this instance, the mother had fallen downstairs while in the seventh nonth of pregnancy. She struck the abdomen in falling, and was much hurt.

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* *Exposition of the Signs and Symptoms of Pregnancy*, case 42, p. 680, 2d ed.

Uterine pains were felt, but they passed off, and the child was not born until three weeks after the accident.

In the second instance, I saw the child some few hours after birth. It was very small, and so ill-nourished that it seemed very doubtful if it could live longer than some few days. The trunk and head were well formed; but the extremities were not in a normal condition. There had been a compound fracture of the tibia in each leg. The fractured bones had reunited somewhat irregularly, the lower portions having been drawn upwards, and the flesh-wounds had not closed. The ulna was wanting on either side, and the lower portion of the fibula was also wanting in each leg. The hands and feet were deformed, and there was double talipes varus.

In this instance two accidents had occurred: one during the fourth month of utero-gestation, when the mother narrowly escaped being precipitated into a deep ravine; and secondly, she suffered a severe succussion in a railway train, six weeks before giving birth to the child. It is probable that the first accident may have occasioned the malformation, and that the railway accident may have produced the fractures.

The *causes* of fractures in utero are twofold. They are induced, on the one hand, by pressure, such as is made by the forceps of the accoucheur; and, on the other, by muscular action; and it is probable that these are the only forces which can act on the fœtus in utero to cause fracture, except in such an instance as that which is related by Montgomery, where the effect of *contre-coup* may well have operated to produce fracture. So long, however, as the membranes remain unruptured, it is impossible to produce the effect of contre-coup on the fœtus; neither is it possible that the walls of the uterus shall compress the fœtus to produce fracture so long as the liquor amnii remains to distend the membranes; and we must, therefore, believe that in these instances of fractures of the long bones the fracture has been produced by the sudden and violent action of the muscles of the limb itself.

Malformation doubtless favours both fracture and distortion, as was clearly the case in the last instance which I have quoted; for here the muscles acting irregularly, through the partial absence of their bony attachments, their opponents readily distort the limb. And the same argument holds good equally of fracture as of distortion; the muscles of the limb acting suddenly and violently on a malformed limb may readily fracture the bone.

The *treatment* of these accidents scarcely requires separate notice; for the bones, at this early age, are so soft and pliable that they may be easily moulded into almost any form. It will sometimes be found, however, that in straightening the bone, however slowly it may be done, the muscles of the limb are rendered rigid; and it becomes necessary, in order to avoid injury to the soft structures, to divide the tendons of those muscles which are rigid—those muscles probably which, by their powerful contractions, have induced the fracture. After division of the rigid tendon or tendons, the limb is readily brought to its normal form by the use of bandages and pliable splints.

BERNARD E. BRODHURST.

Injuries in childhood do not require notice here, since each injury has been already made the subject of a separate description. All that need be said is, that all injuries, both wounds and fractures, and particularly their combinations into compound fractures, are more hopeful in the child than the adult, that they heal more rapidly, and that amputation is less necessary.

Congenital tumours and tumours in childhood.—Tumours in childhood do not differ essentially from those in more advanced life, but are usually of looser structure and more rapid growth. Thus malignant disease affects the medullary rather than the scirrhous form; it grows quickly, and proves speedily fatal if left alone, and if extirpated generally returns in a very short time. The eyeball and orbit are its favourite seats, but the bones are frequently affected, and the testicle not uncommonly. The congenital occurrence of cancer is said to have been observed occasionally.* Amongst innocent tumours, the softer varieties—fibro-cellular, fibro-plastic, &c.—prevail over those of more perfect development. Whatever be the presumed anatomical structure of the tumour, its early removal is imperative; not merely on account of the deformity and functional disturbance which it may produce, but also in order to obviate the effect on the nutritive process which is produced by the rapid growth of a tumour. I have had frequent opportunities of convincing myself that the general health improves quickly, and the child begins to gain flesh and strength, after the removal of a tumour which has previously been increasing rapidly. If so, the inference is obvious, that such rapid growth ought to be rendered impossible, by removing the tumour in its stage of quiescence, in every case where this can safely be done; while, if the growth be advancing, the operation is still more urgently requisite.

The chief peculiarities, however, of tumours in early life are observed in those growths which are congenital. Many congenital tumours are formed by single cysts, which sometimes contain clear serum (as in hydrocele of the neck), sometimes dermoid structures (as in the cysts which frequently present themselves at the upper corner of the orbit), sometimes blood, or fluid exactly like blood (as I have seen in a large cyst occupying the whole thickness of the cheek), and at other times various modifications of serum. Again, other congenital tumours are entirely solid; † and although some of them grow rapidly, they have no character of cancer; ‡ while others remain stationary for long periods, and then begin to increase.§ Between these two kinds (the solid and the cystic) there are numerous transitional forms. In the neck, the occurrence of a widely-diffused and rapidly-growing tumour, composed of soft solid, with numerous cysts scattered about it, has often been pointed out; || and a similar admixture of cysts and solid substance is noticed in congenital tumours in other parts of the body, where the cellular tissue is lax, as in the orbit (see case 5 in the paper above referred to). When formed entirely of solid tissue, this solid is usually of a soft consistence, whitish, and resembling udder on section, not yielding any juice, and consisting chiefly of simple nuclei, with more or less cellular tissue interspersed. The same is also generally the composition of the compound or mixed cystic growths in the neck.

The parts in which these tumours are found are very various. Though most common in the neck, they may occur in any part of the body. Mr. T. Smith, however, in a very interesting paper published in the second volume of *St. Bartholomew's Hospital Reports*, points out the fact that there is as yet no known instance of a congenital cystic tumour in any of the limbs.¶ But as they have been found in the most various situations—in the back simulating spina bifida, on the surface of the tongue, in the orbit, in the pharynx, and in the internal organs—we can hardly avoid the conclusion either that this is accidental, or that the congenital tumours which occur in the limbs affect the solid rather than the cystic form. There is, I believe, no essential difference between the two forms.

The congenital tumours which are met with immediately beneath the skin and mucous membrane are, I believe, usually solid. This was the case in a patient from whom I removed a congenital tumour developed from the deep

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* Walshe on *Cancer*, p. 146.

† See a paper, by the author, on congenital innocent tumours, *Lancet*, May 21 and 28, 1864.

‡ E.g. the cases numbered 4 and 5 in the paper referred to.

§ *Ibid.* case 3; also Mr. Mason's case of congenital tumour of the tongue, *Path. Soc. Trans.* vols. xv, xviii.

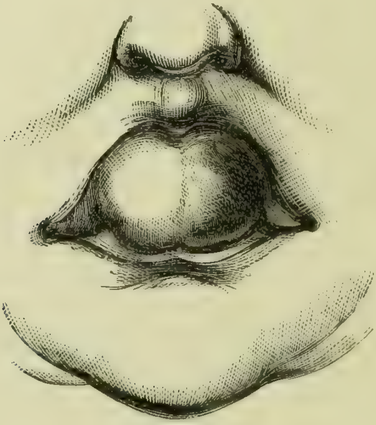
|| Mr. Cæsar Hawkins, *Med.-Chir. Trans.* vol. xxii. Gurlt, *Die Cystengeschwülste des Halses*, Berlin, 1855.

¶ It is to be noticed that Mr. Smith is speaking of *cystic* tumour. Mr. Adams relates a case in which Mr. Lonsdale removed a congenital fibro-cellular tumour from the arm of an infant. *Path. Soc. Trans.* v. 327.

layer of the skin of the nape of the neck,* and in Mr. Mason's patient, from whom he removed several congenital tumours of the dorsum linguæ.† Again, in an infant who died from the development of a tissue of this nature underneath the mucous membrane of the pharynx (probably congenital) which prevented deglutition, I found no cysts in the morbid growth.‡

The subjoined figure represents a similar congenital growth which I once met with below the mucous membrane of the lip, and which, like the other instances that I have seen of these merely superficial congenital tumours, was destitute of cysts.

Fig. 415.



Congenital swelling of lip.

In the orbit I have once seen a very singular congenital fibrocystic growth, which had pressed the eyeball out of the head, leading to its rupture and atrophy, and had then spread some distance on the cheek.

Solid congenital tumours also are sometimes (though rarely) found in the scalp.§ Thus, in April 1864, Mr. T. Smith removed at the Hospital for Sick Children a congenital fibrous tumour of large size and lobular form, measuring nearly two inches in one direction by one inch in another, from over the pericranium, to which it was somewhat adherent. It was very hard, so as almost to resemble exostosis in general characters, except that it was movable, and consisted of purely fibrous elements. The patient was a girl five years of age. The operation was followed by dangerous, I believe fatal, symptoms, which might in all probability have been avoided had the tumour been removed in early infancy.

In Mr. Smith's paper some interesting cases will be found of congenital cystic tumours situated in the middle line of the back, and simulating spinal bifida. The relation of congenital cystic tumours of the perinæum and buttocks to spinal cysts and to included fœtal remains has been discussed above.

As an example of the occurrence of tumours of this nature in the internal organs, I extract the following case from Mr. Smith's paper in the *St. Barth. Hosp. Reports*, vol. ii. p. 19:

'A case of congenital cystic disease of the kidney was brought before the

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* *Path. Soc. Trans.* xii. 207.

† *Path. Soc. Trans.* vols. xv. xviii.

‡ *Lancet*, May 28, 1864, p. 606.

§ Dermoid cysts of the scalp and congenital sebaceous tumours will be found treated of in the essay on Regional Surgery.

Pathological Society by myself for Mr. Marsh.* It well illustrates the rapid growth and large size which these tumours may attain. The tumour weighed fourteen pounds, and was removed from a child seventeen months old, whose weight was more than half made up by the disease. It was first noticed at the age of three months, when it appeared the size of an orange. Although from the first the disease made very rapid progress, it was not accompanied by any special cachexia; and until by its size and weight the tumour interrupted the functions of the abdominal viscera, the child's general health was unaffected. When this, however, took place, the child rapidly emaciated, and died of inanition. During life the disease had been diagnosed by Dr. West and others as a renal tumour.

'After death the tumour was found to lie behind the parietal layer of the peritonæum, which was tightly stretched over its anterior surface. It was covered by a distinct capsule, and had formed no connection, either by adhesion or infiltration, with surrounding parts. It originated in the substance of the left kidney, the remains of which, unaltered in structure, were found spread out in a thin layer over its posterior surface The ureter was healthy; there was no affection of the lymphatic glands; and the remaining viscera were unaffected.

'On dissection, the tumour was found to contain numerous cysts, embedded in a coarse fibrous or reticulated structure. The cysts were of various sizes; the larger ones contained others of smaller dimensions springing from their inner surface. On microscopic examination, the solid parts were found to be of a fibro-cellular structure, the cellular element predominating over the fibrous. The cysts contained a clear serous fluid.'

In all these cases I think it may fairly be argued that the congenital 'tumour,' as for surgical purposes we must call it, is really nothing more than an exaggeration, as it were, of the normal tissue of the part. The polycystic tumour of the neck may be regarded as an enormous development of the natural areolar spaces and of the septa which separate them; so of the orbit, and of the other tumours developed in the loose tissue beneath the fascia in other situations. The solid superficial tumours are thickenings of the corium or of the basement tissue of the mucous membrane; the cystic tumour of the kidney an exaggeration of the natural structure of that organ. Even in Mr. Mason's case of congenital tumour of the tongue, the growths have great analogy to enormously over-developed papilæ. The same may be said of the congenital thickening sometimes noticed in the sterno-mastoid muscle (see REGIONAL SURGERY).

The progress of these congenital tumours, or hypertrophies, is various and very capricious. Sometimes, after attaining a certain size, they disappear spontaneously; a fact of which Mr. Smith, in the paper above referred to, has given numerous examples. Often, I dare say, they remain stationary during life. But at other times, after an indefinite period of quiescence, they resume active growth. Thus in Mr. Mason's case, above referred to, the tumours had been stationary till the age of twenty-seven, when they began to grow rapidly; and Mr. Smith quotes a case from the *Revue médicale* (March 1834), where the same thing took place about the age of fifty. In a paper by Mr. Birkett, read before the Royal Medical and Chirurgical Society, June 9, 1868, the reader will find some singular histories of tumours of this kind which obtained a great development towards the end of middle life. Again, they may grow steadily in infancy, drawing into themselves the elements of general nutrition, and thus producing marasmus. It is partly in this way, and partly, perhaps, by mechanical pressure, that the congenital polycystic tumours of the neck so often prove fatal at an early period. Occasionally, indeed, the progress of these tumours is as rapid and as inevitably fatal, if not effectually checked, as that of a cancer. Finally, there are some, although these are but few, in which the situation of the mass causes only a slight growth to prove fatal, as in the instance of the tumour behind the pharynx to which I referred above.

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* *Path. Trans.* xvi. 171. Mr. Smith remarks that the growth is here erroneously described as 'medullary.'

The affections from which the congenital solid tumour requires to be diagnosed are cancer, fatty tumour, and degenerated nævus. The cystic tumours require besides to be diagnosed from sebaceous cysts, nævi, and, in certain regions, from spina bifida, meningocele, and included fœtus. From cancer there is little difficulty in distinguishing any except the more rapidly-growing polycystic tumours of the neck, and in these cases their great extent, lobed arrangement, and the great cysts full of variously-coloured fluid which they contain, sufficiently indicate their nature to any surgeon familiar with the disease.

From fatty tumour the aspect of the growth and the absence of the dimpling generally produced by pinching-up the skin over a fatty tumour may distinguish the ordinary fibro-cellular congenital growths. Still it should be remembered that fatty tumours may occur congenitally. Thus Mr. Athol Johnstone has recorded a case of fatty tumour growing congenitally out of the sacral canal, to which reference has previously been made (p. 799). Mr. Gay has related * a remarkable case of congenital fatty tumour in the sole of the foot, in which part of the foot was amputated under the belief that 'the tumour was of a *recurrent*, if not of a decidedly *malignant* nature,' but where it proved to be composed of large meshes of connective tissue, in which were contained fat-cells with margarine crystals in the interior of each. Mr. Gay adds, 'the tumour was free of the deep tissues of the foot, and could have been dissected from the skin.' Mr. Gay's report of this case is very full and interesting, and is illustrated by good representations both of the external and microscopic characters of the tumour. While saying, therefore, that the more ordinary forms of these congenital tumours require to be diagnosed from fatty tumour, we must not forget that in some rare cases the latter are also congenital.

From degenerated nævus it is often very difficult to make a diagnosis, indeed impossible without an exploratory puncture; and the difficulty is sometimes increased by the presence of nævus-stain in the skin over the tumour, as in my case in the *Path. Trans.* vol. xii. p. 206. But the diagnosis is not in this instance a matter of much practical moment, since the congenital tumour does not require treatment unless in an active state; and this state of activity would of itself be sufficient to show that it could not be a degenerated nævus. From nævus in its active condition these tumours may be distinguished by their wanting that decided change of volume with the respiratory efforts which is always exhibited by large and growing nævi, by their less uniform consistence, and by the results of exploratory puncture. A nævus will bleed copiously on puncture, its tissue will feel soft, and the point of the needle will be almost but not quite fixed. In a congenital tumour, if solid, there will be nothing following the puncture except the minutest quantity of blood, the tissue will feel quite hard, and the point of the needle will be fixed. If the instrument has been plunged into a cyst, a fluid of variable character, (but not blood,) will run freely out of its groove, and the point of the needle will be perfectly free.

The diagnosis of congenital cystic tumour from meningocele and from spina bifida will be best judged of from the account of these affections. (See also REGIONAL SURGERY.)

Treatment.—A congenital tumour which is not active does not require any treatment at all, unless from its position it be very unsightly or productive of some functional disturbance. It is quite certain that a good many of these congenital hypertrophies disappear as the child grows, and that a further proportion remain without advancing in size for an indefinite period. Still, if the tumour be only small, and the part be one where no danger is to be apprehended, I think it better to remove such tumours at once, in order to obviate any risk in after-life. In larger tumours, where there would be any danger in such an operation, no treatment should be adopted unless the growth is active. If this is the case, the choice lies between several courses.

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* *Path. Trans.* xiv. 243.

If the solid material be in very large proportion to the cysts (and of course still more if there be no cysts), I believe no measure short of excision will succeed; but there is no objection to the previous use of discutient ointments or lotions, if the case is not very urgent. Mr. Smith speaks favourably of weak vermilion ointment; but I question much whether the cures which have taken place under the use of any of these discutients have not been spontaneous.

When the cystic element is in large proportion, the obliteration of the cysts is the first object, and is often followed by the total disappearance of the disease. In Mr. Smith's paper several highly-interesting examples are given of the beneficial effects of small setons in this respect, and some of these examples occurred under my own observation. The remedy is a very simple one, produces little disturbance, and hardly any deformity; and as it is often successful, deserves a trial in any such case. A single fine thread is to be passed through the cyst under treatment, and withdrawn as soon as inflammation commences. After the first seton has produced its effect, a second may be required in another portion of the tumour. I have not myself had any personal experience of this method of treatment, but can bear witness to its success in Mr. Smith's hands. In some cases where the cysts were large and not very numerous, I have seen the best results from iodine injection. Other and more severe measures have been used for the same object, as the prolonged use of large setons in order to obliterate the cysts by suppuration; the introduction of sticks of powerful caustics (the '*cautérisation en flèches*' of Maisonneuve); and the incision of the cysts successively, allowing them to granulate up. These measures should, I think, be rejected. I do not see what object is to be gained by the prolonged irritation of large setons beyond what Mr. Smith effects by the harmless action of small ones; and as to the other two methods of treatment, I have tried them both, but only with the effect of hastening the fatal issue; and I regard them as much more dangerous than total removal.

It only remains to enquire under what circumstances the complete excision of the growth is indicated, and to what extent it is likely to succeed. In the first place, if the growth is rapid, some measure must be adopted to check it, otherwise the infant will either die of the local effects of the tumour (e.g. of pressure on the trachea or œsophagus in tumours of the neck), or from the diversion of the elements of nutrition into the tumour he will fall into a condition of weakness in which he will soon succumb to one of the customary ailments of infancy. In such a case, if the growth be cystic, and the milder measures before spoken of have failed, or if the growth be solid, so that there is no place for them, I think the tumour ought to be removed entire. In the neck the operation is no doubt a formidable one, because these tumours are always below the cervical fascia, and extend to an unknown distance and in various directions among the important structures of the part; and the nearer the tumour approaches to the middle line, the greater is the danger of meddling with it. But then these multiple cystic growths in the neck are very fatal if left alone; and when they have begun unmistakably to take on active growth, there should be no delay in dealing with them efficiently.

In such instances I believe the operation to be called for by the indications which lead us to recommend the removal of tumours in other parts of the body, viz. the immediate effects of the disease, the prospect of danger from the probability of further increase, and the hopelessness of arresting the disease by other means. But one consideration ought not to be overlooked—that is to say, the fact that in many, if not in all of these cases, the disease is less a new growth in any proper sense of the word than a hypertrophy extending to an uncertain distance among the tissues, and devoid of any demarcation, so that it is very difficult to determine what must be removed and what may be left behind, and equally so to be quite secure that the disease will not sprout up again if any portion has been left.

In order to illustrate this, I will quote the following case, which occurred to Mr. Prescott Hewett. I am not aware that the case has been published by him, but it has been more than once referred to under his authority.* A congenital cystic tumour was excised from the posterior triangle of the neck by the late Mr. Keate, in a female infant æt. six months. A small portion of one of the cysts was left, adhering intimately to the subclavian artery. It was not until the age of thirteen that any renewed growth took place, when she was placed under Mr. Hewett's care with a double cystic tumour below the trapezius muscle and the clavicle, as large as the fist. Suppuration was induced in this by means of a seton. This measure was followed by troublesome cough, and finally an abscess broke into the trachea or œsophagus, and she recovered after vomiting a quart or more of fœtid pus. She was seen in good health seventeen years after the operation.

This history shows that in a case in which any minute portion of the cyst-walls has been left behind, there can be no security against the ultimate recurrence of the disease. But, if the previous reasoning is correct, this consideration hardly bears upon the question of treatment. We cannot imagine that there is any more security against recurrence after apparent obliteration by iodine injection or seton. The suppuration which follows in the healing of the excision-wound is certainly more likely to destroy such remains of the cyst, or to deprive them of their secreting powers, than the irritation set up by the other methods of treatment. But such considerations are beside the question if the operation is necessary. I earnestly recommend the operation with all its dangers in certain cases—not of course in place of milder measures (injection or seton) when such milder measures have any chance of success—but in place of measures such as caustics and incisions, which, though in appearance milder, are, I am convinced, as dangerous and far less successful.

Congenital or hereditary, and infantile syphilis.—The poison of syphilis, when it has been conveyed into the constitution from an infecting sore, saturates the blood, and vitiates, as it would appear, the composition of many of the secretions, and amongst others of the semen. From the blood, or from the semen, according as it is the mother or father who is the subject of the original disease, the fœtus often becomes impregnated. This gives rise to a train of symptoms in the infant, which strikingly resemble, and strikingly differ from, those of secondary syphilis in the adult.†

It is necessary, however, before describing the symptoms of this disease in the infant, to say a few words as to the origin of the disease, and as to the important and very difficult duties which its occurrence in a family lays upon the surgeon.

That the children of healthy women may be born with the constitutional taint of syphilis is so common an observation, that the old idea of infantile syphilis being always, or very often, the result of direct inoculation from a sore existing in the vulva of the mother at the time of parturition, is contradicted by every-day experience, no less than by the character of the disease, in which a chancre is perhaps never, at any rate exceedingly rarely, met with. It is theoretically possible that the child might be so infected; but if that were ever the case, the disease would bear a much stronger resemblance to those unfortunate cases in which surgeons contract syphilitic disease from inoculation of a crack on the finger, during the examination of a venereal sore, than to the ordinary congenital disease here referred to. Still the possibility of such a catastrophe renders it incumbent on a surgeon, when delivering a woman who has a chancre in the vulva, to defend the infant as far as possible from contact with the secretions of the sore, by coagulating its surface with nitrate of silver and coating it with collodion.

Practically, however, the *congenital* disease, in the proper sense of that word, is always derived from the blood or semen of one or both parents. Therefore when an infant is born, in whom (by the symptoms which will be shortly described) congenital syphilis is diagnosed, it is the duty of the medical attendant to discover which of the parents is affected, and not to allow (if possible) further cohabitation until the secondary symptoms have entirely disappeared, under the treatment which has been above described in the essay on SYPHILIS. Neglect of this precaution may not only entail on the couple the misery of a family of deformed, puny, and ailing children, but to the woman at least is fraught with grave personal danger. Whatever may be the case among the poor, there is no doubt that in the better classes congenital syphilis is usually derived from the father; the mother being uninfected except through the fœtus. Now it has been, if not absolutely proved, at any rate rendered in the highest degree probable, that a healthy woman carrying a syphilitic fœtus, may become infected with constitutional or secondary syphilis, through the exchange of components which goes on between the fœtal and maternal blood in the placenta. Thus are explained some of those cases in which women, who have never had primary syphilis, have shown all the symptoms of secondary syphilis after living for some years with husbands suffering from secondary symptoms.* There seems also some reason to believe that after such an infection of the sound parent, the disease in the future offspring will be rendered more intense. Otherwise the congenital disease appears to become gradually milder in each succeeding child, as the time of impregnation becomes more distant from that of the original infection of the parent, even apart from the influence of treatment on the latter. This, however, is, by no means a reason for neglecting such treatment.

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* See Mr. Smith's paper, op. cit. p. 21.

† The general question of the connection between the hereditary and the more common forms of syphilis will be found discussed in the essay on that subject in vol. i. p. 453, et sqq.

Again, children may be infected with syphilis in vaccination, or by contact with syphilitic sores on the persons of their wet-nurses or others. We shall recur to this, more strictly speaking, *infantile* variety of the disease, after having described the symptoms of that which is truly congenital.

Symptoms.—The popular name for this disease—the snuffles—indicates one of its most striking features—a discharge which collects in the nose, blocking it up sometimes entirely, so that the infant is unable to suck for any length of time. In extreme cases, this inability to suck becomes a grave, and even dangerous, part of the disease. The nasal discharge is thought, with great probability, to be due to the presence on the mucous membrane of an eruption analogous to the cutaneous syphilide, which constitutes the principal manifestation of syphilis in the infant.† This eruption differs from any of those seen in the adult, most probably in consequence of the different consistence of the skin in early infancy. The spots are usually somewhat coppery, but sometimes of a perfect rose colour, and more resemble roseola than any other of the ordinary eruptions; but the eruption is moister than roseola in the adult. On the soles of the feet and palms of the hands the cuticle usually scales off, and the eruption resembles psoriasis. On the other hand, where the cuticle is very thin, and kept moist by the folds of the skin or by discharges (as about the vulva and perinæum, near the anus and mouth, or in the groin), flat mucous tubercles are usually met with. Eruptions are also met with in the mouth in the form of white ulcers or patches, displaying the crescentic outline so common in various syphilitic affections of the skin. Together with these symptoms there is also observed, in nearly every case of congenital syphilis, a clear indication of the profound affection of the constitution, in the wizened and shrunken look, the anxious expression, and the dirty hue of the skin (a kind of dirty-greenish yellow), which imparts to the infant a peculiarly repulsive aspect of old age even at the threshold of life. There are other symptoms which are not so often seen. Thus various eruptions are spoken of as occurring in a later stage of the disease. In some severe cases the eruption rapidly runs on to ulceration, crusts cover the ulcers, and a state resembling that of impetigo is produced. Papular and ecthymatous eruptions are spoken of, but they seem only slight variations of the ordinary skin-disease. Whether pemphigus in infants is often, or ever, due to syphilis is an undecided question. I have seen it in connection, at any rate, with congenital syphilis, if not caused by it. The affections of the eyes, of the palate, and of the bones, which are so common in secondary syphilis of the adult, are so rare in children that it is doubtful whether the few cases which occur of disease in these organs in infants during syphilis may not be mere coincidences. I have seen each of these organs affected during the progress of congenital syphilis; but not exactly with the same kind of disease as prevails in the constitutional disease of adult life, e. g. the eye attacked with hypopyon and perforation of the cornea, but never with iritis;* large abscesses around the bones, but not nodes or chronic ulceration; sloughing of the soft palate, but not the excavating ulceration of the tonsils, or the caries of the hard palate so common in mature life. Finally, certain lesions or degenerations of the principal viscera have been pointed out as peculiar to congenital syphilis; but I cannot say that the evidence on this subject appears to me very conclusive; at any rate these lesions are of little moment in practice, inasmuch as no means exist of recognising them before death.

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* Mr. Jonathan Hutchinson, in *Med. Times and Gazette*, vol. ii. 1856, and vol. i. 1857.

† See DISEASES OF THE NOSE, vol. iv. p. 272.

Many of the chronic ulcerative affections of the bones, ordinarily spoken of as strumous, appear to me to be the later manifestations of congenital syphilis; but the history is generally so obscure that it is impossible to form a diagnosis, except by the results of treatment. Thus a child was under treatment for a long time at St. George's Hospital, suffering from caries of the tibia and facial bones. Almost the entire thickness of the tibia had been removed at various operations. Ultimately she came under the care of my colleague, Mr. Pick, who, suspecting the venereal nature of the affection, treated it by means of the mercurial vapour-bath. Recovery was rapid, and I believe permanent.

The period at which the disease makes its appearance is a point of much importance in prognosis. Congenital syphilis is a very frequent cause of the death of the fœtus, and consequent miscarriage of the mother; that is to say, the fœtus is affected at an early period of conception. In other instances the fœtus is born alive, but with the characteristic snuffling and eruption; here the infection has not been matured till a late period of fœtal life. In the majority of cases, however, which become the subjects of treatment, the infant is perfectly healthy, to all appearance, at birth; and the disease first shows itself after an interval, which is commonly about six weeks. As a general rule, the period of the appearance of the disease varies with its intensity; and this, again, varies with the length of time which has elapsed since the first infection of the parent, and depends also on the fact of one or both parents being diseased.

Besides the above congenital or hereditary disease, infants may be affected with syphilis, as adults also may, by various methods of contact and of inoculation. That primary syphilis is communicated by actual contact to any part of the body where an abrasion exists (or probably without abrasion, where the cuticle is very delicate), is a fact of as much importance in the infant as the adult; and it has been conceded above that possibly syphilis may in some rare cases be so communicated in the act of parturition, and it may also be accidentally inoculated in infancy, as at any period in life, if the patient is brought into direct contact with another affected with primary syphilis, as when a nurse is suffering from primary syphilis. Secondary syphilis, it seems now agreed, may also be inoculated;† and this is even more likely to occur to infants than adults, on account of the constant contact in which they are held to the bodies of those who nurse them, the frequency of slight pustules and abrasions on their bodies, and the thinness and moisture of their skins. This second source of acquired syphilis in infants is verified by many recorded cases.* But a third source—and one which, on account of its bearing on public health and public policy, is perhaps even more important—is that inoculation of the vaccine virus, which a wise legislation is now seeking to make generally compulsory in infancy. There seems no possibility of denying that syphilis is in some cases inoculated in vaccination. The facts adduced by Mr. Lee (vol. i. pp. 458–460) seem to prove this beyond dispute. It is most consolatory, however, to find that in this country at least this occurrence is so rare that it has never happened in Mr. Lee's own vast experience, nor, I may add, during the many years that I held office at the Hospital for Sick Children did I ever see or hear of a properly authenticated case.†

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* Sir W. Lawrence, however, speaks in his *Lectures on Surgery*, 1863, of iritis as a common symptom in infantile syphilis. Having had numerous opportunities of seeing the complaint among the out-patients of St. George's and the Hospital for Sick Children, I cannot remember ever seeing a genuine case of iritis, nor does it occur in the elaborate enumeration of the symptoms of this disease in Diday's work.

† See the essay on SYPHILIS, ch. viii. vol. i. p. 443.

It appears also, from the experiment related on p. 460 of Mr. Lee's essay, that direct inoculation of blood from a syphilitic patient may propagate primary syphilis. From facts such as these, combined with details of the vaccination performed from the syphilitic infant who was the source of the whole outbreak at Rivalta, and which tend to show that blood was mixed with the lymph introduced, Mr. Lee concludes that the blood, accidentally drawn in vaccinating from this syphilitic child, was the source of the infection; and that to guard against a repetition of such a catastrophe it is sufficient, 1. that a clean lancet should be used: 2. that the lymph should be taken from the vesicles not later than the eighth day; 3. that lymph only should be taken, and that it should be free from the admixture of blood or of other secretions; 4. that the lymph should be taken from a healthy subject. It is greatly to be hoped that these precautions may prove sufficient; and we are encouraged to believe that they may, from the extreme rarity and dubiousness of the occurrence of syphilitic infection after vaccination in this country, as well as from the account of the outbreak in Italy, which shows that it is highly probable that the vaccinator had neglected Mr. Lee's fourth caution; and that if he had carefully examined the infant who was the source of all this mischief, he would have found evidences of existing syphilis.‡

It will be observed that the *infantile* disease, contracted by contact or inoculation, differs in no respect from the usual forms of primary syphilis, except in the seat of the original chancre, and therefore no more need be said about it here. The importance, however, of knowing, and acting upon, the fact that infants may be infected in this manner and may then become the sources of contagion to their previously healthy parents or attendants, rendered it necessary to notice the subject.

There are other sources from which an infant may be infected with syphilis while at the breast. It appears to have been now put beyond doubt that the lesions of secondary, as well as those of primary, syphilis are capable of producing the infecting chancre.§ We may conclude from the facts of every-day experience that such secondary lesions are not sufficiently contagious to convey the disease, except after prolonged and intimate contact, and to a part where the cuticle is either abraded or very delicate; but there are facts which appear to prove that infants (in whom both these conditions meet together) do occasionally contract primary syphilis by contact with persons affected with primary or secondary sores. This occurs most usually where they are suckled by women labouring under syphilis (particularly when the syphilitic lesions affect the nipple or mamma), and the part infected is usually the mouth.

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* E. g. the celebrated case of Chiabrera, the source of the late vaccino-syphilitic eruption at Rivalta, spoken of in the essay on SYPHILIS, vol. i. p. 459.

† A case of vaccino-syphilis was lately exhibited at the Clinical Society, by Mr. T. Smith, in the person of an out-patient at the Hospital for Sick Children. It was, I believe, the first case that had presented itself among the many thousands of out-patients who have been seen there yearly during 13 years.

‡ See op. cit. pp. 183, 184.

§ On this subject see Rollet, *Recherches cliniques et expérimentales sur la Syphilis*, and H. Lee, op. cit.

When, therefore, a child at the breast of a wet-nurse shows symptoms of secondary syphilis some weeks after birth, it will be proper to examine carefully and see whether such symptoms resemble the truly hereditary form of the disease described above, or whether they do not follow on the occurrence of a chancre on the lip, attended by enlarged submaxillary glands. These cases occupy more space in foreign works, probably because wet-nursing is more common abroad than in England; and it appears very usual for wet-nurses to be infected in the nipple by suckling syphilitic infants. In such a condition it is easy to imagine that they might give suck to their own or other uninfected infants, and so a chancre be produced.* Nor are cases wanting in which children have been said to be infected in other ways and in other parts of the body.† But in all these cases the disease, though differing in its seat and alleged exciting cause from ordinary syphilis, differs from it in no other respect; and an attentive examination will usually clear up all difficulties even at some distance of time from the first appearance of the chancre. The treatment must be the same as for ordinary infecting chancre or its sequelæ.

It is perhaps hardly necessary for me to do more than allude in the most cursory manner to the case in which the infants infect the nurse. I have never seen an instance in which this has occurred when the mother has been the nurse, although she might be quite free from any trace of present or past syphilis; but it is impossible to doubt that when suckled by healthy wet-nurses syphilitic infants have often proved the source of contagion. The chancre appears on the areola of the nipple, is accompanied by indurated glands in the axilla, and is followed by alopecia, sore throat and syphilitic eruptions. Cases of the conveyance of the disease to the husband from women so infected are given by foreign authors; but are to be received as true only after the most rigorous examination—if indeed any examination can entirely justify the assumption.

Diagnosis.—The diagnosis of syphilis in children, whether hereditary or acquired, does not usually present much difficulty. The snuffles, eruption, and peculiar cachexia of the congenital disease, together with its persistence, are usually sufficient to characterise the complaint even when its history is concealed or unknown. Non-syphilitic roseolous, or other eruptions, might no doubt occur together with coryza; but such eruptions (and still more the ordinary strophulous affection) yield readily to simple treatment. In a few doubtful cases I have found the child's general condition improve so rapidly under the influence of mercury, that I have no doubt of the propriety of administering that drug when we have good reason for suspicion, but cannot form an absolutely certain diagnosis. In the acquired disease, if seen in an early stage, the appearance of the sores, the enlarged glands which are generally connected with them, and the examination of the mother, nurse, or attendant, will usually clear up the diagnosis. Later on, the eruptions, alopecia, and affections of other organs, must be diagnosed by the same rules as secondary syphilis in the adult; but as the disease is so much rarer in children, more caution will be necessary. In a case of suspected vaccino-syphilis, the points to which attention should be directed in forming the diagnosis are, the state of health of the child from whom the lymph was obtained—if that can be ascertained—the appearance and secretion of the sores, the character of the bubo, and the presence of secondary symptoms after three or four months.‡

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* Rollet, op. cit. pp. 256, 263.

† Thus some of the children who nursed the babies infected by vaccination at Rivalta had sores and suspicious eruptions on their arms and other parts.

‡ It would be a question for the surgeon himself to determine whether he would think it justifiable, in the case of a doubtful sore after vaccination, to test its inoculability on another part of the child's body. If the surgeon held, with Mr. Lee and others of the best observers, that an inoculable sore is a soft sore, and therefore non-infecting, and therefore not requiring specific treatment, no practical advantage could result from the experiment.

Prognosis.—The prognosis of hereditary syphilis is usually represented as very favourable, if only the disease be early treated. I must say, however, that I have seen a good number of syphilitic children die; few indeed from the direct results of the disease, but many from intercurrent infantile disorders of various kinds. In fact, congenital syphilis is a profound cachexia, which renders children far less able to resist any of the numerous febrile disorders to which (especially among the lower classes) they are so much exposed. With this reservation, the prognosis is good for ordinary cases; but those in whom the disease has commenced before birth, and who are extremely stunted and withered, will very probably die, more especially if the nose is so much obstructed as to render sucking difficult.

Treatment.—The only treatment which is at all justifiable in congenital syphilis is the administration of mercury; and the only question therefore is as to the most advantageous way of administering that drug. The method of inunction recommended by Sir B. Brodie is quite sufficient: this is managed by merely keeping a flannel band, smeared with ung. hydrarg. twice a-day, constantly applied to the thigh or the arm for about six weeks. This is the most convenient plan in private practice, or where the surgeon can make sure that his directions are implicitly followed; but in Hospital practice, I have found it more safe to give the drug in the form of medicine—a plan in which the ignorant have more confidence; a grain and a half or two grains of grey powder, with a little of the compound chalk-powder to prevent irritation, may be given night and morning. The calomel vapour-bath may be used, if the parent or nurse is also infected. Whatever be the form selected, the course should be carried on for full six weeks, by which time the eruption will most probably have disappeared, and the child have regained its plumpness and healthy complexion. If not, the mercury should be continued until the cure is complete.

The local treatment is of subordinate importance. In the essay on DISEASES OF THE NOSE (vol. iv. p. 272), Mr. Durham insists on the necessity of removing foul discharges which may become a source of irritation and so propagate disease to the nasal bones. Ulcerations about the genitals may be touched with solutions of caustic or sulphate of copper; and the ordinary applications may be used to sores in other parts. But these measures have little real value beyond their cleansing efficacy. With a sufficient course of mercury, simple cleanliness is usually all that is necessary; without it no local applications do much good.

The remoter effects of congenital syphilis are either direct or indirect. As the ordinary congenital disease bears a considerable resemblance to the secondary symptoms in adults, so there are seen, although only rarely, phenomena analogous to the ordinary tertiary symptoms. The researches of Mr. Hutchinson on interstitial keratitis, and on the deafness which appears to be sometimes a consequence of congenital syphilis, are well known, and have been alluded to above.* Another remote consequence of congenital syphilis which Mr. Hutchinson has pointed out, is the condition of the permanent teeth,† the central pair of incisors in the upper jaw presenting the peculiarities of being generally ill developed, usually small in size and therefore separated from each other, of soft consistence, and marked at a short distance from their free edge by a crescentic notch from which one or more tubercles project, so that the edge of the tooth is notched, lobulated, or irregular. These tubercles soon wear off in consequence of the softness of the teeth, leaving the edge of the tooth crescentic. Syphilitic teeth are also very liable to caries; but the irregularities here spoken of exist in those which are not carious, and are far better observed in such. The same or similar peculiarities may be presented by the outer incisors of the upper jaw, by the lower incisors, and by the canine teeth; but they are less marked, and are not relied upon as diagnostic by Mr. Hutchinson. Both his papers are well worth reading, and his views have been supported by experience hitherto; although the whole question is so difficult on account of the length of time which has elapsed between the supposed cause and its observed results, and also on account of the nature of the disease, that it is very hard in many cases to say whether they tend to support Mr. Hutchinson's views or not.* It is certainly important, in a diagnostic point of view, to be familiar with this alleged syphilitic condition of the central permanent incisors; not to confound it with the numerous other irregularities to which the teeth are liable from hereditary or personal peculiarity, from disease and from neglect; and I may be allowed to add, not to forget that Mr. Hutchinson's doctrine is not intended to apply to the temporary teeth: these, although they may of course be diseased in syphilitic children, do not show any diagnostic peculiarities.

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* See DISEASES OF THE EYE, vol. iii. p. 67; DISEASES OF THE EAR, vol. iii. p. 322.

† *Path. Soc. Trans.* vol. ix. p. 449; vol. x. p. 287. See also the illustration in the essay on DISEASES OF THE EYE, vol. iii. p. 69.

Finally, there are some other tertiary symptoms which are occasionally seen connected with old attacks of hereditary syphilis, but so rarely that the nature of the connection can hardly yet be said to be settled. Thus I have spoken in the note of a case in which destructive ulceration of the soft palate took place in connection with many of the symptoms of congenital syphilis; in another case I have seen laryngitis, requiring tracheotomy, in connection with interstitial keratitis, total deafness (acquired), and lupus exedens. And in connection with the latter disease (which appears to be, though rarely, a symptom of the later stages of syphilis in adults, especially in hot climates), I may say that I am informed by my friend Mr. Nayler that he has seen a case of vaccino-syphilis where the whole arm was covered by a copious eruption of well-marked lupus. That some of the diseases of the bones so common in weakly children may be due to tertiary congenital syphilis is, as I have remarked above, probable, but I think not yet proved.

The treatment of these later stages of syphilis is pretty nearly identical in children and in adults.

Infantile paralysis.—One of the most lamentable, and often, unfortunately, one of the most incurable, affections of infancy is that form of paralysis which is called 'infantile' or 'essential' paralysis, and which differs from the forms of palsy which are described in other parts of this work, as well as from those which are the more proper objects of the physician's treatment, in the important fact that the palsy is not a symptom of any known disease (as is the case in the progressive atrophy of muscles which is described in the essay on DISEASES OF THE MUSCULAR SYSTEM), nor is occasioned by any lesion of the nervous centres or (as far as we know) of the nerves themselves; but is the essence of the disease.

The palsy, or loss of motion, affects single muscles in some rare cases,† but more usually whole limbs (generally the lower), and often the whole of one side of the body. It may even attack both lower limbs, though this is very rare.

This strange affection raises many questions of interest with respect to its causes, its pathology, its diagnosis, and its treatment; as to none of which does it appear that very confident answers can at present be given. In the first place, as to the causes of the essential paralysis of infancy. These can rarely be discovered. In some few cases the affection has followed immediately on exposure to cold, and has affected only the part exposed, as paralysis of one leg after long sitting on a damp stone;* but, in the great majority of instances, no hint is obtained from the history of the disease, except that, as most cases come on during the period of the first dentition,† there is a vague habit of referring the disease to 'dental irritation.' But of the real existence of this irritation there is usually no proof, still less of its having had any influence on the nervous centres. Convulsions sometimes accompany the onset of the disease; but they can hardly be regarded as connected with it as a cause, since the form of paralysis we are here speaking of is quite distinct from that which is caused by disease of the brain.

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* For instance, I had some time since a patient aged about twelve, in whom the condition of the teeth and of the corneæ was strongly indicative of congenital syphilis; he had also lost the soft palate from ulceration: and the very striking improvement which followed the use of iodide of potassium alone, with no other medicine either local or general, strongly supported my first impression that the case was one of tertiary congenital syphilis. Yet I could obtain no account of the original disease; and the occurrence of syphilis in either parent was denied, and with all apparent sincerity.

† I have had two or three cases under my own care, in which the deltoid was the only muscle affected. Sir B. Brodie related a case to Mr. Adams, in which he believed the muscles of deglutition were paralysed. Is it possible that this was diphtheritic?

The causes of the disease being unknown, it is not wonderful that its pathology should be so too. It is regarded with much plausibility by some authors as an affection of the nerves; but against this view is to be placed the fact that the palsy does not always (I believe, not often) correspond in extent to the anatomical distribution of the nerves; and that although the nerve apparently affected may supply both muscular power and sensation, the palsy hardly ever affects the latter function, and if it does, the loss (or what is more common, the exaltation) of sensibility is general over the whole limb. Dissection has hitherto thrown no light on the matter. The muscles are of course atrophied from disuse; but neither in the spinal cord nor in the nerves has anything been found to account for the symptoms.

Symptoms and diagnosis.—The diagnosis of the disease can usually be made with accuracy; but some cases will be left, in which it is not easy to separate essential from symptomatic paralysis. The history of a case of infantile paralysis is usually this: The child has been, as far as it was noticed, in its usual health, or perhaps may have had a feverish ailment of some kind, which has left it weak; when, either suddenly or gradually, it loses the power of motion to a greater or less degree. A slight feverish attack may accompany the commencement of the disease, and during this attack there may be convulsions. The loss of power will always be found at first to be partial, and in some fortunate cases is transitory—the affected muscles regaining their strength as rapidly as they lost it—but in the greater number the palsy increases, till the part can be hardly, if at all, moved. To this second stage of the disease, which may last an indefinite time, succeeds one in which deformities are produced by the action of the unparalysed muscles, in those cases where the palsy affects (as it often does) only one side of a limb. Thus the heel is often drawn up by the unbalanced action of the tendo Achillis, producing club-foot, or the toes are drawn into the sole of the foot; the knees flexed by the hamstring muscles; and I have known a case where the thighs were drawn together by the rigidity of the adductor tendons.‡ During this last stage of the disease the palsy may have more or less subsided in the muscles originally affected.

In each of the stages of the disease, the careful study of the symptoms will usually enable a surgeon to pronounce a correct opinion. In the first stage—that of incipient paralysis—the great point is to distinguish the disease from inflammatory affections of the brain, and from disease of the spinal column. In most cases there is little difficulty, since in the infantile paralysis the loss of power is usually limited to a few muscles, and not complete even in these; while in that which is due to organic lesions of the nervous centres the palsy is usually extensive and complete. To this it may be added that the causes of cerebral paralysis in childhood—as meningitis, hydrocephalus, tubercle of the brain—have their own appropriate symptoms, which must be sought for with care, and will be found wanting in the essential paralysis. I have never seen a case which it was possible to confound with spinal paralysis; and should suppose that a moderate amount of care would always suffice to prove the absence of any spinal affection.*

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* West's *Lectures on the Diseases of Infancy and Childhood*, 4th ed. p. 219.

† Out of 32 cases noted by Dr. West, the disease began in 19 between the ages of eight months and three years.

‡ West, op. cit. p. 228.

In the stage of confirmed paralysis and atrophy the chief point is to distinguish the disease from joint-affection and from progressive muscular atrophy, as well as from the affections of the brain and spine. The latter is usually easy at this stage. As to joint-affections, the question occurs chiefly in the shoulder and hip. In the shoulder there is little difficulty. The arm affected by essential paralysis of the deltoid is relaxed in all the parts around the joint, and the head of the humerus hangs down at some distance from the glenoid cavity, partially dislocated by the weight of the arm itself. There is no pain or difficulty on passive motion. The hip-joint is less easily under observation, and the morbid sensibility which accompanies some of these cases of paralysis gives more resemblance to hip-disease on first handling the limb; but the distinction is usually easy to make. Paralysis generally affects a great part or the whole of the lower limb; hip-disease only causes loss of movement of the part affected: in the former passive motion is easy and causes no pain, or not more than any other motion: in the latter the joint is stiff, and an attempt to move it causes acute suffering, not occasioned by any other movement: finally, in paralysis there is no wasting of the buttock, unless the whole limb is wasted, nor is the position of the trochanter ever altered. From progressive muscular atrophy, or 'wasting palsy,'† the rare occurrence of that disease in infancy, and its progressive advance, will suffice to distinguish it. In its latest stage, of contraction and deformity, the disease is sufficiently marked.

Treatment.—Infantile paralysis, then, consists in a sudden or gradual loss of power in certain parts, unaccompanied by any inflammation, or by any symptom of disease of the brain or spinal cord. The main consideration in its treatment is the natural progress of the disease. Some authors take a more sanguine view of this subject, and say that there is a natural tendency to cure,‡ but this seems to me to apply only to milder cases of the disease. In such cases the palsy is often transient, and the usual remedies for any disorder of the health which may be present will get the credit of having cured it; but in confirmed cases (that is when total inability to use any muscle or set of muscles has lasted for several weeks), I cannot say that I have seen much benefit from treatment. In the early stage, while there is some feverish affection, and perhaps a tendency to convulsion, antiphlogistic remedies may be employed, such as purgatives, and the continuous use of mercury.§ But the internal indications usually point to the use of tonics, among which Dr. West speaks well of strychnia. He says, 'I have never yet given it to infants; but with children of four years old I begin with an eighth of a grain of the spiritous extract of nux vomica three times a day, increasing the dose by degrees, to a sixth, a quarter, or a third.' ‖ In a very interesting paper, recently published in *St. Thomas's Hospital Reports*, new ser. vol. i., Mr. Barwell speaks well of the injection of strychnia in minute doses under the skin. When all disturbance of the general health is over, but the paralysis persists, local measures afford more hope of cure than general treatment, viz. passive and active movements, stimulating applications, and galvanism. The palsied limbs should be well rubbed and gently shampooed twice a day; the child should be encouraged, coaxed, and if possible forced to use them (for the palsy is not often complete); for which purpose any games that it can be got to take pleasure in, or a baby-jumper, or a go-cart, will be found useful. The linimentum cantharidis has often seemed to me to be of service; and galvanism, if carefully and scientifically used, certainly does good in some cases, though it often fails in others apparently quite similar. In the final stage of the disease, when deformity has been produced by the uncontrolled action of the unaffected muscles, much good may be done by carefully contrived apparatus aided when necessary by tenotomy.* Very often it will be found that the child who has previously been doubled up, and whose limbs have all been rendered useless, can in this way be put quite straight, and enabled to stand with the assistance of supports, and even to walk a little with the help of assistants; but I have not hitherto seen a case of confirmed palsy in which any greater improvement than this was obtained, though I have continued patient treatment by all known methods for many months.

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* I should perhaps mention that cases are recorded in which an enlarged gland or tumour has pressed on a nerve, and caused palsy of the parts supplied by it. In cases of localised palsy, therefore, the course of the great nerves of the part should be examined.

† This name is given to it in a treatise by Dr. Roberts, of Manchester, which the reader will do well to consult. The disease in question is described in the essay on DISEASES OF THE MUSCULAR SYSTEM, vol. iii. p. 630.

‡ See a paper by Dr. Bierbaum in *Journ. f. Kinderkrankheiten*, vol. xxxii.

§ Gross says, 'Mercury has been strongly recommended in this disease, given in minute doses several times a day, for several successive months; but although such a plan of treatment is extremely plausible, I cannot say that I have ever derived any benefit from it, in a large number of cases in which I have employed it.' *System of Surgery*, 1st ed. vol. i. p. 796.

‖ Op. cit. p. 229.

For an account of the curious disease which occurs in childhood, and in which the muscles are degenerated with apparent hypertrophy, I must refer the reader to Dr. L. Clarke's essay on DISEASES OF THE MUSCLES, vol. iii. p. 635.

Gangrene.—Cases every now and then occur in which gangrene comes on with frightful rapidity, and without any obvious cause, in children—usually those who are debilitated by some previous febrile ailment. Such a case took place some years ago at the Hospital for Sick Children, in the person of a little boy who was convalescent from measles, and about to be discharged. He had made no complaint of any sort, but the nurse in undressing him found both feet black in patches. Three hours before, his stockings had been put on, and the feet were then natural. The child was examined, the case found to be really one of gangrene, and the patient of course put to bed. The gangrene extended with great rapidity, reaching as high as mid leg next day, when he died. There were also patches of gangrene on the elbow and hand. No cause was discovered on post-mortem examination to account for this rapid invasion of gangrene.† Such cases are of course very rare; but in two situations gangrene is very common in childhood, viz. in the face, cancrum oris; and on the vulva, noma vulvæ. The former affection has been already described, having been used in the essay on GANGRENE, vol. i. p. 159, as an illustration of one of its spontaneous forms. The latter form of gangrene is very frequently seen in children's hospitals, though I cannot recall any instance of its spontaneous development in hospital; and from this circumstance, as well as others in its history,—viz. the aspect of the children; the rarity, to say the least, of its occurrence amongst the children of the upper classes; and the success attending its treatment,—it seems pretty certain that it is the direct consequence of bad food and inattention, more particularly if the child has been previously ill: but cases often occur in children who have had no known illness. And the fact that noma may occur independent of any irritation of the genital organs is proved yet more unmistakably by the occasional commencement of noma pudendi far away from the mucous surface, sometimes even in the skin of the groin. In such cases, again, irritation (such as that of erythema intertrigo) may have preceded; but I have seen instances where no such cause was alleged, and where the sloughing commenced in the fold of the groin. Whether the real exciting cause in these cases is glandular abscess may be sometimes doubtful; but I am confident that I have seen cases where the sloughing commenced in the groin, the genital organs being free from disease. The first symptom noticed is usually a dusky colour of the skin of the labia, and foul discharge, with pain in micturition. The parts swell, and soon assume a gangrenous colour, the slough being bounded by a halo of inflammation extending to the groins. At the same time there is much depression, loss of appetite, and occasionally vomiting. The treatment consists in stopping the extension of the gangrene, supporting the strength, and regulating the condition of the bowels. For the first purpose nothing seems so appropriate and so successful as the application of the strongest nitric acid. This caustic is peculiarly successful in the gangrene of children in all its forms. Sloughing phagedæna in adults often proceeds unchecked after the application of the acid; but in all the cases (which certainly have not been many) that I have seen of its application for sloughing phagedæna in childhood, the gangrene has been at once checked. So also in cancrum oris. Whenever the extent of the disease has been such that it has been possible to steep the whole gangrenous surface in the acid, the disease has been checked. Noma pudendi is not less, in fact it seems to be more, under the influence of this remedy; and there are few cases which will resist its timely and thorough application, if conjoined with the proper measures of general support; but the application must be both thorough and timely. As soon as the disease has declared itself, or as soon as the child is brought under treatment, chloroform is to be administered, the parts well separated by an assistant, and the whole of the sloughing surface freely steeped in the acid. Next day, should any part appear to have escaped the application, or should the gangrene be spreading in any part, that part should be again freely cauterised in the same way. Some surgeons prefer the actual cautery; but I have found the nitric acid so successful, that hitherto I have had no experience of any other caustic. After the cauterisation, a poultice should be applied to hasten the separation of the slough, and a lotion of carbolic acid may be poured into, or placed around, the poultice to correct the fœtor. A purge may be given at first, if the tongue is foul, and bark with chlorate of potash, or with ammonia, or some other diffusible stimulant, given in as large doses as can be borne—wine and food being allowed as freely as the child will take it. In cases where the general strength is not extremely depressed, and where this treatment is adopted early, it is almost uniformly successful: but in the opposite circumstances, even though the gangrene may be stopped, the child, without any obvious symptoms, will sink and die. No post-mortem appearances are found in such cases. After recovery there appears to be little deformity; but I have had no opportunity of seeing whether any trace of the ravages of this disease persists in after life.

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* I quite agree with Mr. Barwell as to the importance of avoiding tenotomy in these deformities from paralysis, whenever the limb can be got into a natural position without operation.

† *British Medical Journal*, 1857, p. 387.

The reader may find in the *Lancet*, 1850, vol. ii. p. 578, the account of a case under Sir W. Fergusson's care, where the vulva became entirely obstructed by adhesion of the labia majora in ulceration or sloughing following on measles. This is not expressly related as a case of noma pudendi, although perhaps it ought to have been, measles being one of the recognised causes of that affection. In the cases of noma which I have myself seen, the vaginal opening has seemed rather widened than contracted. In noma, however, and all other ulcerative affections in these parts, it is our duty not to lose sight of the child till the surface is soundly healed and contraction is no longer to be apprehended. If contraction is impending or is recent, it may perhaps still be possible to dilate the parts. In case of old contraction or adhesion of the labia, some plastic operation will in all probability be required. In the case referred to, the adherent labia were simply separated, and an attempt made to keep them apart; but the success was imperfect.

Infantile leucorrhœa.—The vagina in children also sympathises in the child's general condition in another way, which very often falls under the surgeon's notice. This disease occurs as a copious discharge of a purulent or muco-purulent fluid, much resembling the discharge of gonorrhœa, and usually supposed by the child's mother to be the result of impure connection. In the great majority of cases no such connection has occurred, and the suspicion ought to be dispelled from the minds of the parents, as it frequently gives rise to unfounded charges. But in a few cases there is no doubt that a criminal assault has been the source of the disease. No diagnosis, as far as I am aware, can be made between the ordinary infantile leucorrhœa and a gonorrhœal discharge which has been caused by connection unaccompanied by violence,* except in some very rare instances in which, the child having been seen very soon after the occurrence, spermatozoa have been detected in the vagina.† But if any force has been used, either to compel the child to submit, or in order to effect penetration, the marks of bruising or laceration will afford valuable evidence. The common infantile leucorrhœa comes on with some inflammation of the parts, causing a good deal of itching and complaint in passing water. The labia are swollen and red, and often more or less excoriated. The discharge soon sinks into a chronic condition, and may remain so for an indefinite time. The general health is usually more or less feeble, and the child often suffers from worms. Attention to the state of the general health and of the bowels, fresh air, chalybeates, scrupulous cleanliness, and the liberal use of astringent injections, will usually cure the complaint; but it is often slow in subsiding. Care must be taken in injecting to use a small syringe, and do no violence to the parts; and it is advisable to dry the vulva well afterwards, and smear some oil or lard over it to obviate the contact of the discharge. If the disease be known or suspected to be gonorrhœal, little variation need be made in the treatment; except perhaps that, as the complaint will commence with more acute symptoms, poppy fomentation may be used for the first few days, and the child kept to bed.

Condylomata are not common in children, notwithstanding the frequency of vaginal discharge. Mucous tubercle is a very common symptom of congenital syphilis; but it is usually under the influence of mercurial applications, combined with the internal use of mercury; in more obstinate cases the acid nitrate of mercury may be required, and is pretty sure to remove the tubercle. It is but rarely that we are called on to treat, in childhood, the large villous masses of condylomata that so often come before us in adults, when the subjects of venereal affections. In children, condylomata may be safely and efficiently treated under chloroform by removal with scissors, and searing the base with the actual cautery: if the growth is at all large, it is far better to resort at once to this radical operation—which gives no pain, or very little, when the cautery-iron is thoroughly applied—rather than to trust to the slower and more painful action of the potential cauteries, though these will succeed in slight cases if combined with the most scrupulous cleanliness.

Tumours of the vagina.—The vagina is in some rare cases the seat of soft tumours, which, if not congenital, are rapidly developed in very early life. A female infant was under Mr. Athol Johnstone's care some years ago, at the Hospital for Sick Children, in whom a bleeding warty growth existed inside the labia, looking somewhat like ulcerating condyloma, but with no syphilitic history. It had been treated by a course of mercury for some months at another hospital, as syphilitic, but got worse. The application of the acid nitrate of mercury effected a cure. In another case under my care the vagina was filled with a large mass of semi-solid matter mixed with cysts, looking something like a bunch of grapes. I pulled away as much as I could, and applied a caustic to the base of the tumour; but whether with permanent success I do not know, as the child was removed from the hospital by her mother. Such tumours may be excised if their attachments render it possible; but even then the free hæmorrhage that would be produced is undesirable in infancy. In the case just described it would have been impossible to cut away the tumour, in consequence of the small size of the vagina and the depth from which the mass protruded. Probably caustics would be in all cases the best, and of these the acids or the electric cautery would be the most manageable.

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* Mr. Cooper Forster gives a curious case, in which a woman communicated gonorrhœa to two girls by washing them with her own sponge, op. cit. p. 125.

† I am told that this occurred in a case at King's College Hospital, a short time ago.

Rickets is a disease peculiar to childhood; for though the effects of rickets are perceptible in the deformity which it produces throughout the whole of life, yet all active symptoms always subside long before puberty. The softening of the bones, which occurs in later life, and to which the name of mollities ossium has been given, is to be distinguished from the infantile malady.*

The term 'rickets' has reference to the distorted condition of the bones, especially those of the limbs, which is the most striking feature of the disease.† This, however, is only a symptom of the constitutional cachexia which is the essence of the complaint. As in syphilitic, cancerous, and scrofulous affections of the bones, so in rickets, the local condition is only the expression, as it were, of a latent and undetermined tendency in the whole organism, which, as in the diseases referred to, attacks other parts as well as the bones. But, unlike those diseases, the affection of the bones is in most cases of rickets a matter of far greater practical importance than that of remoter parts. Accordingly, in the short sketch which my space will allow, I shall dwell more on the local than the constitutional features of rickets. Those who desire to obtain a more adequate view of this important subject may consult the valuable lectures of Sir W. Jenner, in the *Medical Times and Gazette*, vol. i. 1860.

The chief symptoms of rickets are as follows: The ends of the long bones and those of the ribs, where they join on to the epiphyses or the costal cartilages, are noticed to become swollen and knobby. This enlargement is particularly perceptible in the carpal ends of the radius and ulna. Soon the limbs become weak, so that sometimes, if the child has begun to walk, it is 'taken off its feet;' or else the power of walking is not attained at the usual time; in other cases the child continues to walk, but at the expense of increasing deformity of the extremities, producing bow legs, and deformity of the spine, causing one of the species of curvature. This deformity is a consequence of a peculiar process of softening which goes on in the shafts of the bones. The morbid anatomy of rickety bones has been described with great minuteness by the German anatomists, and in our own language in the excellent lectures of Sir W. Jenner.‡ It will be sufficient here to say that the chief changes are a large production of growing tissue at the epiphysial ends, a softening of the bony tissue of the shafts, attended with enlargement of the lacunæ, which are occupied by a red pulpy substance, and a great thickening of the periosteum.§ In the flat bones, especially those of the cranium, a considerable increase in the thickness of the whole bone results from this thickening of the periosteum and enlargement of the lacunar tissue, and the large size of the head generally noticed in rickety children is due partly to this thickening of the cranium. The softening of the bones soon reaches such a degree that the bones bend under the influence of external force and of muscular movement. The extent to which each of these mechanical causes influences the curvature of the limbs, of the chest, and of the spine, is a matter of much interest, and of some importance in practice. As to curvatures of the spine and as to pigeon-breast, the reader will find all that is necessary in the section by Mr. Shaw on those subjects. Rickety curvature of the limbs is, no doubt, produced by both causes. Where powerful muscles (as the deltoid) are inserted at an advantageous angle into the shafts of the long bones, deformity is generally very marked in advanced rickets; while, on the other hand, the deformity is as marked in situations, such as the forearm and the tibia, where no adequate muscular force can have been acting on the bone, and where the curve is obviously due to the weight supported by the hand in crawling, in the first instance, and by the legs in walking in the second. The softened bones are also peculiarly liable to fracture from slight causes. These fractures are very frequently unaccompanied by laceration of the periosteum, on account of the slight force that has produced them, and the thickened condition of the latter membrane, and are often of the incomplete or 'greenstick' variety. The fragments in many cases are kept in apposition by the thickened periosteum; hence, when the disease is not in a very acute stage, rickety fractures generally unite kindly. Slight causes, however, soon reproduce them; so that rickety children sometimes present almost as miserable (though by no means so hopeless) a condition as adults affected by mollities. The softened condition of the bones also induces deformities of the walls of the great cavities of the body, which have a very material influence on the viscera contained in them. Mr. Shaw's essay will point out the great influence which an insufficient expansion of the chest in infancy has upon the shape of its walls, by exposing the bones to atmospheric pressure. Much more powerfully will this force act when the bones are softened even beyond what is natural in infancy. Hence one of the causes of deformity of the chest in rickets may be conceded to be the pressure of the atmosphere upon the softened bones, induced by incomplete expansion of the chest, the result of laryngismus stridulus, or of collapse of the lung-tissue—common affections in weakly children. A second cause is the outward pressure on the lower ribs, caused by enlargement of the liver and spleen, often present in these cases;* and a third (which seems rather theoretically probable than absolutely proved) is the inward traction upon the cartilaginous extremities of the ribs by the attachments of the diaphragm. The result is a constriction of the chest, much as though a string had been tied tight round it below the heart, whilst its apex is distended. Except in very severe cases, this deformity of the chest may be expected to be effaced as the child recovers from the constitutional taint.

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* See Mollities ossium, in DISEASES OF THE BONES, vol. iii. p. 794.

† The term 'rachitis' was originated by a committee of the College of Physicians (one of whom was Glisson), about 1645. 'One of us,' says Glisson, 'in searching for a name, hit upon that of *rachitis*, which took our fancy immediately.' Glisson remarks that the disease which they christened 'rachitis' was vulgarly known by the name of 'rickets' (hence it follows apparently that the latter term is not derived from the former). Can 'rickets' be derived from the old French word *riquet*, which is the same as *bossu?* Some have supposed both 'rickets' and 'riquet' to come from the German *Rücken*.

‡ See also M. Broca's researches, quoted, in the translation of my work on *Children's Diseases*, by Dr. Larcher, p. 567.

§ See Dr. Merei, *Disorders of Infantile Development*, p. 157.

The pelvis is often the seat of deformity, whereby its outlet is much narrowed, the tuberosities of the ischia being pressed towards each other, and the pubic arch widened; or else the face of the pelvis is pressed backwards towards its posterior wall, the tuberosities of the ischia are thrust outwards, and the pubic arch widened.† In some cases, again, the whole pelvis is said to retain the small size and imperfect development of infancy. Any of these deformities will of course oppose a serious, and perhaps insuperable, obstacle to parturition in after life; and the change of shape of the outlet is often a source of embarrassment in lithotomy in children. This embarrassment, however, seldom proves serious; but a case is on record in which the operator was obliged to abandon the attempt to reach the bladder on this account, although a renewed attempt was more successful.‡

The existence of a constitutional cachexia is proved in some cases by an interval of languor and general ill-health preceding the appearance of any disease in the bones; but very generally the latter symptoms are the first which attract attention. The disease commonly begins before the age of two years, although often earlier, and even in intra-uterine life, forming one of the causes of congenital fracture. The child, if it has been able to walk, loses that power: if it has not, it does not make the usual efforts to 'find its feet.' It loses the activity both of mind and body which is natural to early life, and its muscular strength diminishes. Enlargement of the ends of the long bones where the shaft joins the epiphysis, and of the ribs where they join their cartilages, is early noticed; and soon the fact of the bones being softened is proved by their yielding to mechanical force, and becoming distorted. The enlargement of the joint-ends is most perceptible at the wrist and ankle, especially the former, on account of the superficial position of the bones; and therefore the swollen state of the ends of the radius and ulna, together with that of the ribs, is the familiar test of the existence of the disease; but dissection proves that the same condition exists in the deeper-seated bones. It must not be forgotten that a slight enlargement at this part of the bones is natural in very early life.

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* On the enlargement of the viscera in rickets see an interesting paper by Dr. Dickinson, *Med.-Chir. Trans.* vol. lii. The author shows that the enlargement is due to a different deposit from that of lardaceous or amyloid degeneration—that it bears some analogy to the affection of the bones, and that it rapidly disappears as the disease yields to treatment.

† Humphry, *on the Skeleton*, p. 447.

‡ Sir H. Thompson, in *Med.-Chir. Proc.* Nov. 24, 1863.

There are some other symptoms which, although they are not essentials of the disease, nor can be relied on to diagnose it in the absence of the affection of the bones, yet are very constantly met with in rickets. These are retarded dentition, retarded closure of the fontanelle, enlargement of the head, sweating of the scalp, and a tendency to throw off the bedclothes at night. Muscular weakness is also generally a prominent symptom, even beyond what the softened condition of the skeleton would account for. The assemblage of such symptoms would lead to the suspicion of impending or commencing rickets, and in consequence to prophylactic treatment founded on such suspicion; but the enlargement of the ends of the bones with softening of their shafts is the only diagnostic mark of the actual presence of the disease. Reference must again be made to the following section, by Mr. Shaw (p. 871), for a description of the arrest of growth and development connected with rickets.

Rickets, in milder and ordinary cases certainly, and in all cases probably, tends to a natural cure. The deformed bones become consolidated, and remain, during life, in the shape which they have thus been caused to assume. They are then thicker and heavier than the natural bones.* The stature is thus diminished; but the constitutional vigour and the muscular strength is soon recovered when the cachexia has passed away, and the child, though small, is strong and sturdy. There are cases, however, in which the viscera of the chest have suffered from the pressure of the softened bones, or in which the child's life is endangered by collapse of the lung, or laryngismus stridulus, affections which the softening of the parietes of the chest makes doubly dangerous. From these causes many rickety children die.

The diagnosis of rickets is generally easy. The swellings of the joint-ends of the bones and of the bony ends of the ribs, the constriction around the chest, the bent limbs, the large abdomen, the large head and small face, the habit that the child displays of tossing off the bedclothes at night, the perspiration of the scalp, and the frequent occurrence of bending or fracture of the bones, are symptoms of unmistakable import. In early cases, the disease may generally be detected by the condition of the epiphyses and the shape of the chest.

The medical treatment of rickets is much the same as that of scrofula. The child is to be placed, if possible, in a pure air, and fed upon nourishing and simple food; the skin is to be excited to healthy action by periodical bathing and sponging; the state of the secretions is to be carefully attended to. Cod-liver oil appears in most cases to be beneficial, and a little iodide of potassium may be combined with it; or the syrup of the iodide of iron, or some of the preparations of iron. Phosphate and superphosphate of lime used to be combined with iron at the Hospital for Sick Children, under the idea of supplying material directly for the consolidation of the bones; but after a patient trial, it was thought that the cases did not do better than under the use of iron alone.

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* In this stage of rickets premature consolidation of the diaphyses and epiphyses sometimes occurs, leading to still further want of height, and to the dwarfed condition occasionally noticed.

The surgical treatment of rickets is a matter of more doubt. Some physicians teach that the deformity of the limbs cannot be reduced by splints; that the weight of the splints on the lower extremities is liable to be injurious to the pelvis, and increase its tendency to deformity, while it is a great obstacle to the use of the weakened muscles, and so hinders healthy exercise; and for these reasons discard the use of splints altogether, and advise that the child should be kept at rest and hindered from walking, when the healthy action and balanced tone of the muscles will, it is hoped, do what is possible to redress the curvatures of the softened bones. But, with submission to men of high authority, I cannot help thinking that this is an error. I believe that I have seen crooked limbs very materially straightened by the judicious use of light firm splints, always supposing that the case is presented to the surgeon before the stage of consolidation has arrived; for afterwards the use of splints can only do harm. At any rate, they exercise a most beneficial influence in opposing further deformity; and in cases where it is important to prevent the child from standing or walking, they may be so applied as to project below the foot, when they more effectually prevent locomotion than any attention of the nurse or mother could do, more especially among the poor, who have seldom the power of attending exclusively to one child. For these reasons, I am in the habit of using splints in most cases of rickets where the bones appear still softened. They should be removed at night, and reapplied after the child has been washed in the morning. They should be carefully padded, and are best fixed by a long piece of the webbing which is sold by saddlers. On no account should splints be used longer than while the bones appear to be softening. After consolidation is effected, their pressure can do no good to the curved bones, while it will assuredly cramp the action of the muscles and impede the restoration of their power. In the slighter cases of rickets the deformity almost, or altogether, disappears as the child grows.

T. HOLMES.

Lateral Curvature of the Spine.

The above title is given to a distortion of the chest properly, which originates in lateral curvature of the spine. The term 'Scoliosis' (σκολιός, tortuous,) has been proposed as a synonym. 'Latero-spiral curvature' might perhaps be preferred, as indicating that the spine was not only curved sideways, but was contorted by rotation of the vertebræ on their long axis, at each bend.

The degree of deformity of the chest, shoulders, hips, or trunk in general, caused by the combined incurvation and twisting of the spine, is, in many cases, extremely great. But the changes in the forms of the bones are brought about by actions altogether distinct from morbid processes. Patients in whom the distortion is taking place do not suffer from any illness. When the opportunity of examining the structures after death occurs, they are found quite sound except for the distortion. In the sequel it will be shown that all the phenomena of the deformity admit of being explained on the assumption that the alterations are effected by natural processes of the economy, modified only by accidental disturbing causes. An important distinction is therefore to be drawn, in regard to the causes producing them, between it and Angular Deformity of the spine from Caries; and between them both and curvature of the bones generally, including the spine, from Rickets.*

Lateral Curvature is incident to youth. Commencing insidiously, without warning from bad health, it can only be stated generally that the first appearances of it may be looked for at about ten or fourteen years of age. The progress which it makes at first, in correspondence with the youthfulness of the patient, is commonly rapid; in proportion as the bones become more consolidated with increasing years, it is slower; and at about seventeen, when the skeleton has nearly reached maturity, it may be said to have arrived at its last stage; it is then comparatively stationary; neither disposed to advance, nor capable of being amended by treatment.

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* See article, *Diseases of the Spine*, vol. iv. Also below, p. 869.

A distinguishing characteristic of Lateral Curvature is, that it is incomparably more frequent in girls than boys.

Moreover, it is met with among the daughters of the rich in tenfold greater numbers than in those of the poor.

Predisposing causes.—The chief peculiarity in the construction of the vertebral column, which makes it liable to become incurvated, is that, although its chief office is to support the superincumbent weight, it is at the same time flexible. Again, this many-jointed pillar, instead of resting on a fixed foundation, is reared upon one which is constantly changing its level. The pelvis, upon which the spine is erected, is poised on the globular heads of the thigh-bones, and it rolls and pitches at various angles according to the positions of the limbs. The column is, therefore, subject to be deflected from the perpendicular at each shifting of the base, when the weight it sustains will be thrown unequally on its articular surfaces.

The spine, at the age when Lateral Curvature commences, has attained nearly its full length. That forwardness is in conformity with the development of the cord within, for the slight addition to the column which takes place later is made at the base alone; that is, below the level of the cord itself, and in the region of the 'cauda equina.' The subsequent increase in the general height is chiefly owing to the elongation of the lower extremities, the growth of which goes on till adolescence.* But although thus advanced in length, the ossification of the spine has not made equal progress. The cartilage is in disproportionately large quantity compared with bone. The epiphyses on the upper and under surfaces of the bodies consist chiefly of cartilage. The texture of the bodies themselves is porous and spongy, and their surfaces in relation with the epiphyses, instead of being flat, are partly convex and rounded as in infancy; the pedicles, laminæ, and processes of the posterior segments of the vertebræ, besides being deficient in density, are imperfectly moulded in shape; and the borders of the articular facets of the oblique processes, instead of consisting of bone, are edged with cartilage.†

The muscles which elevate the spine are distinguished both for their great number, and the variety of the directions in which they severally act. That arrangement appears related to the fact, that the extensive movements of the column consist of many combined lesser motions performed in a series of adjoining vertebræ. It may likewise be a means of providing for the prompt adjustment of the superincumbent weight to the centre of gravity, in the numerous deviations of the spine from the straight line in the ordinary motions of the frame. It may be added that these muscles are inserted into the vertebræ close to their centres of motion; they will therefore act upon them at a mechanical disadvantage; but the power thus lost is amply compensated for by the assistance which they derive from the elasticity of the column.

For keeping the muscles of the spine in a state of average strength, it is necessary that a proper amount of active, varied exercise should be allowed. But in the case of young females of the class of society in which lateral curvature is most common, certain circumstances tend to prevent them from obtaining it. The age at which the deformity commences coincides with that at which a notable change takes place both in the physical and moral constitution of a female. As the period of puberty approaches, a girl begins to show tokens of her feminine character. Having been previously, like her brothers, full of animal spirits and fond of romping games, she spontaneously takes to sedentary occupations. And the style of her education harmonises with her disposition. The time given to learning and accomplishments is disproportionately great compared to that allotted to the bodily graces and preserving the health. Being obliged to sit at the piano or other lessons for long periods together, the young pupil naturally gets tired. But she instinctively finds that by stooping or bending to either side, she can relieve herself from the fatigue. And the explanation is this: by throwing herself into these awkward attitudes, she removes, if not wholly, in great part, the task of supporting the spine from the muscles of the back, and imposes it on a different class of structures: when she stoops or bends excessively, not only are all the ligaments of the spine, elastic and others, brought into a state of tension, but the various tendinous expansions, layers of fasciæ and intermuscular septa, connected with the muscles of the back, are extended and act as ligaments in upholding the body. Now the fibrous structures enumerated are devoid of sensation, and incapable of feeling fatigue. But the result of indulging in these lounging habits is, that the ligaments and allied parts become overstretched and unqualified to knit the bones together. It is as if the shrouds of the mast of a ship had been slackened and required bracing; and owing to the loosened and relaxed condition, the muscles are overtasked to keep the column erect.*

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* Infra, p. 871.

† Two preparations of the spine, preserved in spirits, showing the extent of ossification of its different parts at the age when lateral curvature commences, are contained in the Museum of the Middlesex Hospital.

Another source of weakness of the spine, indirectly involving the osseous and ligamentous structures, may be traced to muscular debility. When the muscles lose power, the loss is felt beyond their own sphere. It is a law of the animal economy, that an intimate relation should exist between the muscles which originate force, and the bones and joints which bear the brunt of it. The mutual connection may be illustrated by the case of the trained boxer. In proportion as the power of his muscles increases, the density of the bones and tenacity of the ligaments are augmented. Were it otherwise, and the muscles of the arms acquired great strength, while the humerus and the ligaments of the elbow, for example, were relatively weak, he would be in danger of fracturing the one or dislocating the other, when he inflicted a heavy blow with his fist on his adversary's head. And the converse is equally true; in proportion as the muscles diminish in power, the bones become less solid, and the ligaments less capable of resistance. Applying the law to the state of the bones and joints of the spine, it will be seen that when the muscles have been debilitated by inaction, a corresponding degeneration of the internal structure of the vertebræ and of the ligaments will ensue.

On viewing the mechanism by which the apparently inconsistent qualities of stability and mobility are combined in the spine, it will be observed that the vertebræ rest and move upon each other only at three distinct surfaces of contact, above and below respectively. These are, anteriorly, the fibro-cartilaginous articulations of the bodies; and, latero-posteriorly, the articulations of the wedge-shaped oblique processes. When the spine is straight, the pressure of the superincumbent weight will be divided equally among those surfaces; and no damage need be apprehended. But it will be otherwise when the column is inclined to either side, and is allowed to remain curved. The effect which will be produced on the concave side of the curve will differ from that produced on the convex; but both will tend, each in its own way, to render the bend a permanent one. When the spine leans to one side, it is obvious that the weight of the body will fall exclusively on the articulations situated on the side to which it leans, and that a convergence of the adjoining structures will take place: hence the force acting on this, the concave side, will be one of compression. Again, it is obvious that the effect of the inclination on the articulations of the convex side, will be that of separating the surfaces, and producing a divergence of the connecting structures: accordingly, the force here will be one of dilatation. Now it is important for our subject to observe the changes which will be produced in the articulations by the operation of these distinct forces. By the former acting on the concave side, namely, compression, there will be, as the first change, overstretching of the ligaments, which will allow the surfaces to glide past each other beyond normal bounds, in a downward or converging direction; and subsequently the bony structures will come into collision and undergo absorption. By the force of dilatation acting on the convex side, the ligaments will be overstretched in an eccentric or expanding direction: the surfaces will thus be allowed to keep apart; absorption will not take effect; and the bony structures will preserve their natural forms and dimensions. The general result will be that the vertebræ included in the curve will receive a bias to incline sideways, first, from the weakness of their articu-

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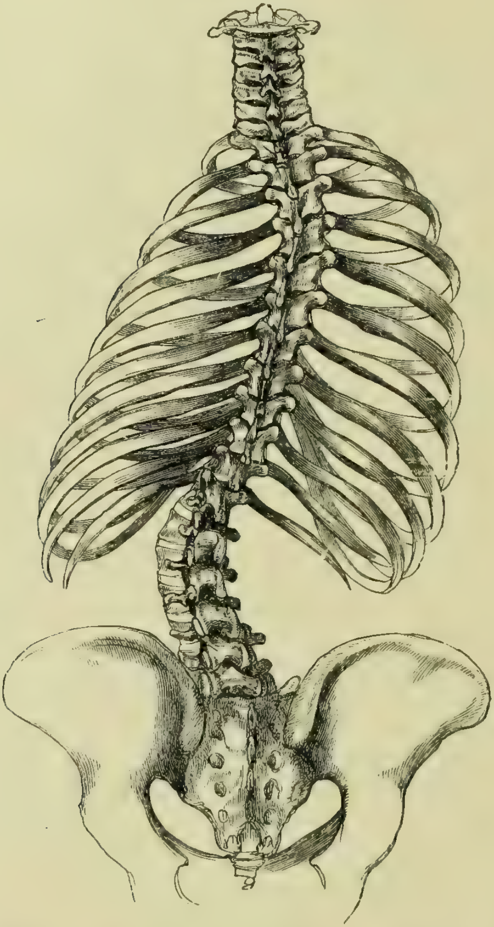
* Much stress is commonly laid in orthopædic works upon the bad effects of tightly-laced stays in inducing Lateral Curvature in those who wear them. But it is not customary for girls of the tender age at which the deformity commences to be dressed with stays of that kind. It is their older sisters alone who can be charged with the vanity.

Fig. 416.*



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* The figure represents the curvatures and contortions of the spine, with the changes in the positions and forms of the ribs, in a case of lateral curvature, at a comparatively early stage of its progress—when, perhaps, just recently discovered by friends.

lations, and next, from the unequal changes in their bony surfaces and processes. And such, it may be added, constitutes the beginning or starting point of lateral curvature.

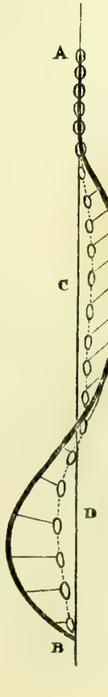
General Appearances of Lateral Curvature.—The deformity varies considerably as to the degree of the incurvations, and their relative places in the spine, in different cases; but a typical form can be recognised in all, proving their identity in origin and kind. According to it two curvatures coexist; one above the other, and one balancing or opposing the other; so that together they describe a serpentine line, like the italic letter *ſ*. The superior curve is situated more or less high in the dorsal region; the inferior occupies the lumbar.

In general the curvatures just mentioned are the only ones. But if the dorsal be lower than usual, a curve in an opposite direction, formed of upper dorsal and lower cervical vertebræ, will probably be found. Again, in the sacrum, a slight diminution of breadth on one side may represent the presence of a curve there, the counterpart of that above in the lumbar region.

The course which the different curves follow, in reference to the sides of the body towards which they respectively bend, is so uniformly the same in a large majority of cases, that it appears governed by a general law. Thus, looking first to the lumbar curve, experience shows that, in about nine patients out of ten, the column is deflected from its base to the left side, and that it is then inclined to the right; thereby forming an arc, the concavity of which is on the right. As to the dorsal curve, the direction it takes is determined by that of its fellow; for as the one is placed counter to the other, the arc it describes will be concave on the left. In those exceptional cases in which the above rule is departed from, the course of the curves is reversed; the concavity of the lower looks to the left, and that of the higher to the right

But the curvatures do not consist simply of lateral archings of the spine. Combined with each curve to either side, there is a vertical twist in the column, consequent on a partial rotation of the vertebræ on their long axis. And the direction of the contortion in reference to the curve is constantly the same; that is, the revolution of the vertebræ is always such, that their sides corresponding to the concavity are wheeled forward, and those on the convex side backward. It follows that, as the spine is bent laterally, and also contorted longitudinally in the upper curve, and is also similarly bent and rotated in the lower, but in a contrary direction, a spiral or cork-screw condition will be produced; or the column will present an appearance not unlike what might be supposed to result from taking it, when soft, at both ends, and twisting it between the two hands as a washerwoman wrings a wet cloth.

Fig. 417.



And here it may be convenient to notice a source of deception connected with the contortion, to be guarded against in examining a young person's spine for the detection of lateral curvature. The ordinary way of proceeding is for the surgeon to run his finger down the ridge of spinous processes, and by dotting the tip of each in its turn with ink, obtain a line representing the curves. To prove the fallacy of the method the adjoining diagram is introduced. The bold, outer, curved line is intended to show the course of the bodies of the vertebræ; the faint dotted one that of the apices of the spinous processes. It will be seen that the combined effect of the twofold incurvations and contortions in the dorsal and lumbar regions is to make the tips of the spinous processes, above and below, range themselves into a line which is nearly straight. That result is owing, first, to the fact which has been stated—that in the contortion accompanying each curve, the spinous processes point toward the concave side; and, secondly, to the concave aspects of both curves, upper and lower, being turned in common to the median line of the body. It follows, of course, from the apices of the processes in each equally approaching the median line, that the joint curvature which they describe will deviate but slightly from a straight line. Hence it is obvious that a false idea will be given, by trusting to that mode of examination, of the extent of the curves as existing in the bodies of the vertebræ, on which parts the stability of the column mainly depends.

Formation of the curvatures.—The enquiry may now be made how the two principal curves originate, with the order of their succession, if they follow each other.

Anatomical reasons point to the probability that the lumbar curve is first formed. 1. The vertebræ of that region, being situated at the bottom of the column, have the whole superincumbent weight accumulated on them. 2. This part of the spine is highly flexible: decidedly more so than the dorsal. 3. Owing to the unstable character of the base—the pelvis—on which the lumbar vertebræ rest, they are more prone than others to be deflected from the perpendicular.

The question may therefore be asked, if there be any particular position into which the lumbar vertebræ are liable to be habitually placed, which might expose them to become permanently curved. Now, there is a particular posture into which persons have an instinctive tendency to place themselves for the sake of getting relief when fatigued in their lower limbs, either from walking or standing; and while indulged in, the spine is bent laterally at the loins. The attitude is known in the drill of soldiers as the position of 'standing at ease.' And a special mechanism is introduced into the human frame in connection with it. The part of chief consequence in the apparatus is that strong membranous web which covers the muscles on the outside of the thigh as a sheath, and is called 'fascialata.' This dense structure is attached extensively above to the external lip of the crest of the ilium, and is continued below into a similar fascia on the outside of the leg. The way in which the mechanism acts is as follows: The foot of the person having been solidly fixed on the ground, with the knee extended, the pelvis, carrying the body with it, is allowed to drop into an oblique position to the opposite side. The consequence of this inclination is, that the side of the pelvis which corresponds to the leg on which the person stands is elevated. But a further result ensues; the elevation of the crest of the ilium, to which the fascialata is attached, causes that membrane to be put into a state of tension. In other words, the expanded membrane acts the part of a ligament in restraining the pelvis from falling too far sideways; it therefore, in effect, supports the weight of the body. It may be added, that, owing to the same lateral inclination of the pelvis, the head and neck of the femur are drawn outwardly from the acetabulum to the extent of putting the capsular and round ligaments on the stretch; they will therefore assist in locking the hip joint, and fixing the pelvis. In that manner, the task of keeping the body upright is thrown off the muscles and given up to fibrous or ligamentous parts; and it follows that, as these structures are devoid of sensation, they can perform the duty without fatigue.*

But what is of greatest interest in connection with the attitude, is the curvature in the spine required for preserving the equilibrium. The appearance of that deviation will be best seen by observing a young person whose joints are flexible, lounging lazily on one leg. A large sweeping curve, equal to about a semicircle, will be found extending from the lower part of the dorsal region to the sacrum. Now, if it be admitted that the posture is one of ease, which gives relief to the muscles of the limbs when fatigued, and is, moreover, frequently indulged in, it may be granted that the curve will be prone, in a young, growing person, especially of delicate frame, to become permanent. The vertebræ, and all the structures connecting them, will be in danger of undergoing changes in their forms and relations, to accommodate themselves to the position. Supposing, therefore, that the curvature has become confirmed, and that it is situated principally in the loins, what effects may be anticipated?

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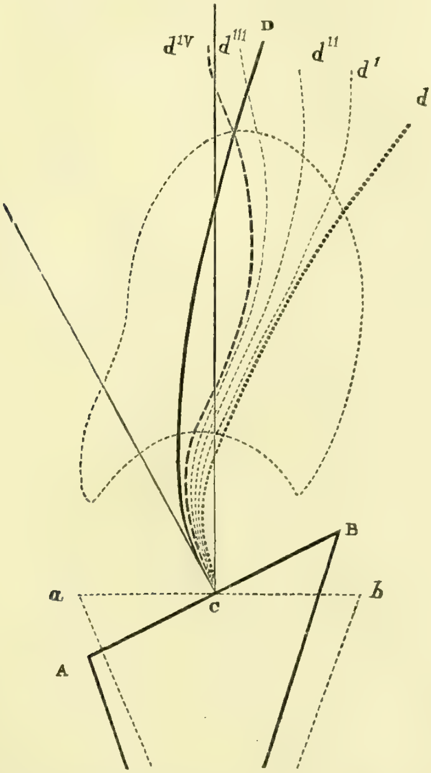
* Among the lower animals mechanical appliances for economising muscular exertion, analogous to that in man, but differing in construction, are met with. The bird which roosts, has one kind of apparatus; that which sleeps standing on one leg, has another. Although the horse has four legs, he is not without a provision in his hind quarters, and the mechanism is like that in man, for relieving his over-worked muscles.—*System of Anatomy and Physiology*, by John and Charles Bell, vol. i. p. 385, 7th ed.

It is obvious that so long as the person in whom the curve exists can keep the pelvis poised in its oblique position, he will experience no inconvenience, because the deviation is adapted to it. But the circumstances will be greatly changed when he adopts a posture in which the pelvis is necessarily horizontal. That is the case in sitting or in walking. It may therefore be expected that when a person in whom the spine has acquired a permanent bend near the base sits or walks, not only the column, but the whole superstructure reared upon it, will fall extensively to one side.

Fig. 418.



A, B, oblique line of pelvis when standing on right leg. C, D, curvature of spine consequent on oblique direction of the pelvis. a, b, horizontal line of pelvis, as in the posture of sitting; C, d, position into which the spine, having become curved in the loins, is liable to fall when the pelvis is placed horizontally. The curve in the loins being permanently established, the exertions of the patient to restore the equilibrium tell only on the part of the spine above. The dotted lines, C, d^{i}, d^{ii}, d^{iii}, d^{iv}, indicate different stages in the formation of the dorsal curve.

It might, perhaps, be thought that this lumbar curve could be rectified by the patient exerting the muscles of the back to prop up the spine, or by poising the pelvis in a contrary line to the first. But these attempts will be unavailing for two reasons: First, they will not succeed on account of the changes in the relative dimensions of the two sides of the vertebræ, and of the connecting structures contingent on their curved shape; secondly, owing to the contortion of the vertebræ which invariably accompanies lateral incurvation, the several processes and articular surfaces are so much altered in their relative positions that they become mutually interlocked. and the movements between them are checked or arrested. Accordingly, as the lower curve cannot be overcome, and the equilibrium must be restored, the only alternative is the formation of a new one above it, and in counteraction of it. The spinal muscles on the convex side act on the upper part of the spine; and by gradually raising it and drawing it toward the median line, they eventually bring its summit over the seat of the centre of gravity. The muscles attached to the head and to the shoulders contribute to adjust them also, and direct them to their correct places. Thus the superior or dorsal curve is formed.

A part of the problem remains to be solved. It has been pointed out at p. 859 as a remarkable feature of the deformity, that, in a large majority of cases, so great that the exceptions to the rule are few, the direction of the curves is such, that the one situated in the loins is concave on the right, and the one in the dorsal region consequently concave on the left, of the body. If the explanation of the mode of formation of the lumbar curve given above—namely, that it is from an acquired habit of standing on one leg—be correct, it may then be inferred, as accounting for the concavity being on the right side, that the right lower extremity is more frequently selected for standing upon than the left, because by resting on it the curve takes that direction. Now, it coincides with our knowledge of the comparative strength of the members of the two halves of the body, as well as of their obedience to the will, to suppose that the right should habitually be preferred. Man, it may be alleged, is right-footed, as he is right-handed. And we are not without an argument in favour of the supposition derived from military drill; the posture of the soldier, when ordered to 'stand at ease,' is alike in the disciplined armies of all countries; he places the right limb firmly under him, straightened and fit to support the weight of his body; while so doing he elevates the right and depresses the left side of his pelvis; the left leg is consequently relaxed and bent; and as the shifting of the pelvis has the effect of making the base of the spine oblique, he is obliged to lean his body to the right in order to recover his balance; thus a curve of the spine, which is concave on the right side, is formed.*

Causes of the contortion.—It may now be enquired into, how the twisting of the spine on its long axis, which is an invariable accompaniment of the lateral incurvation, is produced. The contortion is about equal in degree both in the lumbar and dorsal curves. The rotation has also a definite relation to the curves; being always directed in such a manner that the concave sides of the vertebræ are wheeled forward, and the convex, of course, backward.

It has been stated above (p. 857), when adverting to the surfaces and processes by which the vertebræ are articulated, that the only solid structures, as distinguished from the muscles and ligaments, which intervene to check or arrest lateral movement in them, are the oblique processes. It was also shown that, when the muscular and fibrous structures were inefficient, and the spine inclined to one side, the effects produced on these processes by the pressure of the superincumbent weight differed essentially on the two sides of the column; that from the weight being received wholly on the concave side, the oblique processes of that side were shortened and flattened by absorption; while, owing to the processes on the convex side escaping compression, they preserved their normal shape and size, and diverged from each other. The influence which this contrast in the rate of consumption of the substance of the vertebræ on the two sides may have in causing contortion to be combined with lateral incurvation, will be apparent when we take into view the relative position of the processes to the central axis of the spine. They are placed postero-laterally in the vertebræ. Consequently, at the same time that the column falls sideways, a rotatory movement, in a partially horizontal plane, will take place upon the oblique processes of the concave side as centres or pivots; and the vertebræ will, therefore, perform an imperfect gyration, with their sides, which have undergone the chief destruction, pointing forwards.

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* For additional illustrations, see *Treatise on the Hand*, by Sir C. Bell, p. 92, 6th edition.

From this description it may be perceived that the addition of the contortion to the lateral incurvation will conduce very considerably to the deformity becoming rapidly worse, when it has once begun. It has been seen that, in conformity with the vertebræ being rotated with their concave sides forward, the oblique processes of that side are carried toward the front. Now, the effect of that movement will be to transport them to the place of principal danger; for, by travelling forward, they will be brought into the part where the curve of the spine is most acute, and where the pressure from the superincumbent weight is also greatest; and they will, therefore, be exposed, in an especial manner, to undergo destruction of their substance by absorption. Again, as the curvatures will increase in proportion to the wasting and shortening of the processes, new sets will be constantly involved or drawn literally into the vortex; and the deformity will progressively get worse.*

Special appearances at different curves.—Trunk.—Decrease of height, and increase of breadth in the trunk generally, with disproportionate length in the lower extremities, are early exhibited appearances in persons affected with lateral curvature. The arms also seem preternaturally long, in contrast with the shortness of stature. These defects are obviously consequent on the diminution in the height of the spine caused by the incurvations.

Lumbar curve.—Owing to the thickness of the mass of muscles in the loins, and the natural arching of the vertebræ forward causing a hollow behind, the lumbar part of the column does not come so distinctly into view as the dorsal; hence it is not always easy to discover a curvature in it, especially at its incipient stage. The only apparent sign of there being one may consist in the waist being peculiarly short and broad, which indicates that the lumbar vertebræ have yielded to the pressure of the superincumbent weight and become curved. To estimate the weakness of the part, the patient may be instructed first to place herself in a lounging posture; the clumsiness of the waist will then be perceptibly aggravated; but by asking her again to make a strong effort to elevate her body, a visible improvement will take place: not only will the length of the waist be increased, but its natural slimness will be restored; and that condition will last so long as she continues the exertion.

Supposing the deformity more advanced, the first thing perceived in the loins will be a want of symmetry between the two sides—a narrowness and fulness on the one, and an expanded sunken condition on the other; the contrast being more apparent if the patient stand in a slouching position. In correspondence with what has been stated above (p. 859), that, in a large majority of cases, the curvature in the lumbar region is convex on the left side, it may be expected that the fulness referred to will be situated on that side. This consists in a prominent ridge, which follows the contour of the lumbar curve, on its outer or convex aspect. It is caused by the combined incurvation and contortion of the vertebræ of the loins. The former has the effect of making the lateral surfaces, especially the transverse processes, on the convex side, diverge; the latter causes the same parts to project posteriorly. Accordingly the muscles which lie upon the vertebræ on that side will be stretched, and also thrust back, so as to form a curved, rounded swelling. If the contortion be considerable, the consequent displacement of the muscles may be so great that their inner margins, in relation with the vertebral ridge, will overlap the points of the spinous processes, and conceal them. As in cases of slight curvature, the fulness may not be easily recognised, the best mode of bringing it into view is to direct the patient to bend forward, as in making a bow, when the inequality will be distinctly visible.

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* *On the Nature and Treatment of Distortions of the Spine and Chest. Engravings illustrative of the above work, in folio*, 1824, by John Shaw. 'Paper on Rickets,' by the writer, *Med.-Chir. Trans.* vol. xvi. p. 468. 1832.

In proportion as a lateral curve at any part of the spine becomes more acute, the accompanying contortion is increased; and the bulging at the convex side, chiefly caused by the latter, is augmented to a corresponding degree; so that the affected part presents the appearance, in extreme cases, of a defined angular projection rather than of a curve. That condition is more commonly witnessed in the dorsal than the lumbar region; yet cases have been met with, in the loins, wherein the rotation of the vertebræ on their long axis has equalled not less than quarter of a circle in its circuit; and in which the vertebræ at the principal bend, when looked at from the back, were seen in profile instead of posteriorly. In a case of that kind, in the person of a surgeon, the protuberance on the side, of a globular shape, was so large, and the boundaries apparently so well defined, that the displaced vertebræ were actually mistaken for some morbid outgrowth.

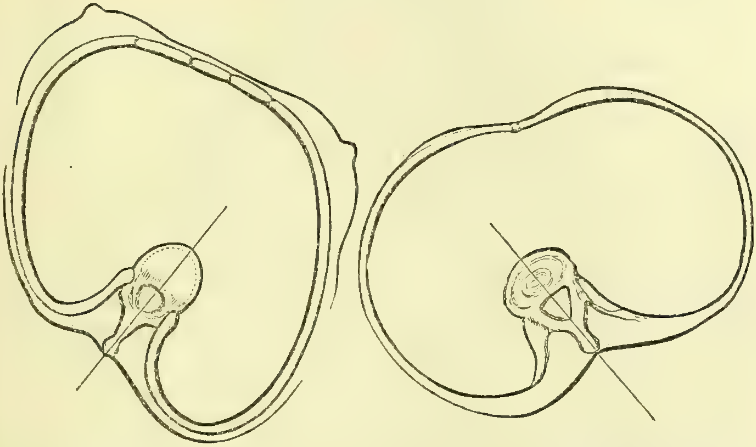
Another effect produced upon the figure, by the lumbar curve in connection with the pelvis, may be noticed. As the vertebræ spring from the sacrum, they incline, in the first part of their course, at such an acute angle to the left that they follow the line of the brim of the pelvis, and are in close proximity to it. The consequence of this near approach is that the boundary of the upper margin of the wing of the ilium is concealed; and the surface of that part of the region of the hip being nearly on the same level with that of the ridge of the spine, they appear merged into one. The result is, that the hip seems not only greatly enlarged, but elevated above its normal height.

Again, the intrusion referred to of the inferior vertebræ into the left lumbar and iliac regions, causes a remarkable change in the figure and relative position of the waist. The contraction which constitutes the waist, and is more strikingly marked in the female, owing to the comparatively larger size of the pelvis in that sex than in the male, is situated directly above the upper border of the wing of the ilium. But in consequence of the encroachment of the lumbar vertebræ into that part, the hollow is filled up, and a fulness or bulging takes its place. Hence a substitute for the waist must be sought for at a higher level. Now, the only hollow on the left resembling that which ought to be found at the crest of the ilium, is a constriction situated altogether above the lumbar region; namely, the narrowing of the chest, just below the scapula, caused by the convergence of the ribs in correspondence with the concavity of the dorsal curve. The representative of a waist, therefore, on the left side, has its place in about the centre of the thorax, instead of between it and the pelvis.

The appearance of the lumbar region on the concave or right side of the curve, presents a general contrast to that on the convex. Owing to the spine receding from its base to the left, in forming the curve, the right side has greater breadth across than the opposite; and owing to the column being rotated on its long axis with the right sides of the vertebræ forward, a flatness, or hollow, or even a flexure in the surface, is produced. But a notable difference between this side and the convex will be perceived, especially in the form and situation of the waist. Owing to the inclination of the spine to the left, the right side of the pelvis becomes particularly distinct, and juts out like a promontory. Consequently this lower boundary of the waist comes conspicuously into view, and the flexure above is abnormally deep. The contraction, however, on the left, which alone corresponds to a waist, is merely a hollow in the side, from depression in the ribs, and is situated far above the level of the proper place of the waist: so that a line drawn between them would be highly oblique, instead of horizontal.

Chest.—From the upper or dorsal curve being situated in the part of the spine to which the ribs are attached, the walls of the chest are included in the deformity. Again, as the scapulæ rest on the chest, the position of the shoulders is also involved. Further, owing to there being a natural stoop forward at the dorsal region, the features of the distortion are rendered to a certain degree more distinct than below. And it may not be omitted to mention that the difference in the amplitude of the dress worn by ladies above and below the waist, has some share in making the upper attract greater notice than the lower curve.

Fig. 419.



Supposed transverse section of the thorax about its middle: to show the displacement of the ribs consequent on the contortion of the dorsal vertebræ.

Diagram representing a supposed transverse section of the abdomen, at the lumbar region.

On examining the dorsal region of a patient in whom the deformity is incipient, the first thing to be remarked will be, as in the loins, a want of symmetry on the two sides. Supposing the case to be one of an average kind, there will be increased fulness and elevation on the right, and contraction with depression on the left. The line of the lateral curve will be traced by following the course of the spinous ridge. But in order to estimate the accompanying contortion, the elevations on each side of the ridge, corresponding to the transverse processes, must be looked to; when that upon the convexity will be found abnormally protuberant, and that upon the concavity proportionately depressed.

Attending next to the ribs: the changes in their position are twofold, depending on distinct causes. Taking the convex side first, the ribs radiate from the spine, like the rays of a fan, so that the distal ends are separated and the intercostal spaces enlarged; but in addition to this, they project backwards. Looking next to the concave side, the ribs converge, like the spokes of a wheel concentrating to the axle, and their distal ends approximate; but in addition, they advance forward. Hence it will be perceived how the right half of the chest, as looked on posteriorly, should be both abnormally expanded and protuberant; and the left both contracted and depressed. Again, it will be found, as might be anticipated, on turning the eye to the front, that the anterior ends of the ribs and costal cartilages are flattened or depressed on the convex or right side, and prominent on the left. These changes in the directions of the ribs depend, it is obvious, on the analogous ones in the spine: the ribs being like the indicators on a dial plate, magnifying the movements at the centre. The radiation on the convex side results from the divergence of the articulating surfaces appropriated to the ribs on that aspect of the spine, connected with the lateral incurvation; and the projection posteriorly results from the rotation of the vertebræ on their long axis, connected with the contortion. A similar explanation, but with the order of the changes reversed, applies to the concave side.*

Shoulders.—From the scapulæ being placed loosely on the summit of the chest, and retained in their places only by the muscles, and by their articulations with the clavicles, they are free to rise, sink, protrude or recede in conformity with the variations in the forms of the chest. As the upper ribs, of the convex side, which support the right scapula, are both elevated and directed posteriorly, the shoulder is not only raised above its ordinary level, but projected backwards: hence it is high and bulging, as if enlarged, and fits closely against the side. The ribs on the concave or left side are pointed downwards and forwards, so as to cause a general collapse of the upper region of the chest: the scapula is thus deprived of support, and is held in its place principally by its attachment to the acromial end of the clavicle: the shoulder, therefore, falls down by its own weight and that of the arm below its proper level; it also stands off apart from the body, with a flattened and pendulous appearance. It will presently be seen that, in certain extreme cases of the deformity, in which the ribs on the convex side are wound about the vertebræ as a consequence of the contortion, that side is diminished transversely and loses its rotundity: the right scapula will then descend from its elevated position to the level of its fellow on the left. Occasionally the chest, together with the shoulders, is turned, as upon a pivot, by the wheeling round of the spine, to such a degree that its left side will face to the front and its right to the rear. The clavicles will revolve equally; and the displacement of one of these at its sternal articulation from this cause has been known to be so great, that it has pressed on the trachea, so as to threaten suffocation, and necessitate partial excision.

Now, on comparing the line which represents the level of the shoulders, with that representing the waist, it will be perceived that each inclines in an opposite direction to the other; that the former dips from the right side to the left, and the latter from the left to the right. Again, the high and protuberant right shoulder is counterpoised by the apparently-enlarged haunch on the left; and the sloping, pendulous left shoulder, standing off apart from the chest, has a counterpart on the right in the projecting ala ilii, jutting out above the hip.

Gibbosity.—When lateral curvature, from neglect, becomes worse, the increase is almost always more rapid and extensive in the dorsal than the lumbar region. Yet, when the different structures of the two parts are observed, it might not be supposed that such would be the case. In conformity with its office of giving support to the ribs in respiration, the dorsal portion has comparatively little freedom of motion; and its mobility is further limited by the ribs being applied along it on each side, like splints. But the rigidity of its structure does not render the part less liable to suffer from the causes which give rise to the deformity. When the process of absorption is excited by pressure, the destruction of substance which it produces is greater on its being met by a dead, inert force, than by one which is elastic and yielding; and it appears to be owing principally to the want of resilience in the structures composing the dorsal region, in contrast with the lumbar, that the curvature advances more rapidly and to a worse condition in it, than in the latter.†

The divergence and protuberance of the ribs on the right side, causing the corresponding scapula to be elevated, and to project backwards, are the first stages in the formation of the abrupt prominence which becomes a 'hump:' and as the spine bends, and becomes contorted to a greater degree, the gibbosity is naturally augmented. But soon an increase in the acuteness of the 'angles' of the ribs, with a flattening of their centres or bodies, appears. That change is obviously caused by the progress of the rotation of the vertebræ on their long axis. As the spine revolves, the ribs are drawn to it, just as a rope in machinery is coiled about a barrel in circular motion. Accordingly, in proportion as the vertebræ rotate, the proximal ends of the ribs travel backward, and, by so doing, increase the acuteness of the angles. Again, as a resistance is made to the posterior movement by the attachment of the distal ends of the ribs to the sternum, a stretching force is applied, which has the effect of straightening their arches and flattening their contour. As the contortion advances, the line of angles is carried further backward, till it forms a prominent ridge, concentric with the spinous, and more prominent. The muscles which lie in the vertebral groove are so much displaced by the twisting of the column, that their inner margins overlap the tips of the spinous processes, and conceal them. When the deformity has proceeded thus far, the next stage in its progress is, that the proximal ends of the ribs, from their articulating heads to the angles, inclusive, are transported bodily round, in their bent condition, by the circumvolution of the column, so as to be in actual contact with the sides of the vertebræ, and to be coiled upon them. The twisting of the spine on its long axis is, of course, very great in these extreme cases—being equal, it may be estimated, in certain of the vertebræ, to nearly a quarter of a circle; and at the same time that the contortion proceeds, the spine becomes more acutely bent. From these combined causes, a prominent enlargement, standing out abruptly from the centre of the back, with expanded ribs overlying the spine for its summit, is formed, constituting the hump.

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* The appearances described above will be made more distinct by the patient's stooping, so as to protrude the spine and adjoining ribs; as well as by crossing the arms in front, a-kimbo, to draw the scapulæ forward.

† This is exemplified by the mode of enlargement of an aortic aneurism. When the tumour has arrived at the walls of the chest, it perforates them by absorption.

Simultaneously with those changes on the convex side, equally great ones are being wrought on the concave. In proportion as the spine revolves, the sides of the vertebræ and the ribs connected with them are carried forward; and as the column bends increasingly, the articular ends of the ribs are caught and enclosed in the deep parts of the angle formed by the upper portion of the spine with the lower. Consequently, the sides of the vertebræ, more particularly the oblique processes, and the posterior halves of the ribs, undergo heavy pressure from the superincumbent weight. Hence they become extensively wasted by absorption. Large portions of the postero-lateral parts of the vertebræ disappear; the intervertebral substances are greatly thinned, and the bodies present a skewed appearance. As to the ribs, they are not only huddled closely together, but are attenuated so as to be scarcely thicker than goose-quills.*

It is manifest that important encroachments must have been made on the space within the chest, intended for the heart and lungs, by the changes in its parietes just described. All that part, for example, contained between the portion of the walls which had become folded about the spine, and the spine itself, on the convex side, would be lost to the pleural cavity. Again, from the contraction of the chest on the concave side, the room for the lungs would be greatly diminished. It may likewise be conceived that much embarrassment in the actions of respiration would result from the remarkable disfigurement of the ribs, particularly at their articulations. Nevertheless it is known that the various organs possess an extraordinary power of accommodating themselves, without impairment of their functions, to changes in their forms. Although, in extreme cases of distortion, the compages of the thoracic and abdominal cavities present both singular irregularities, and all the viscera contained in them undergo a new moulding of their figures to adapt them to the changes, yet each organ performs its function soundly. Thus the spinal cord submits to be altered both as to dimensions and shape, in accommodation to the tortuous form and abrupt angular bendings of the vertebral canal, without

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But the parts which yield most rapidly are not the intervertebral cartilages, the costal cartilages, or the skin, which are elastic, but the vertebræ, ribs, and sternum, which are relatively rigid.

* The ribs coiled round the spine on the right or gibbous side, are broader and more expanded, besides being generally larger, than natural. That increase may be attributed to their having been subjected, while being wound about the vertebræ, to a dilating force, in contrast with a compressing one.

loss of function. On the concave sides of the curves, the intervertebral foramina become contracted and partially closed: it might be supposed that the spinal nerves would be pinched and injured in their passage through them; but experience does not show that any bad consequences follow.*

Mobility at junction of curves.—From the displacement upon each other of the several vertebræ, together with the changes in their figures, and derangement of their articulations, consequent on the incurvations and contortions, it may be anticipated that there will be great impairment of the motion of the spine at each of the curvatures. And observation proves that such is the case. If a patient be placed in the prone position, and extension and counter-extension be employed to straighten the curved portions, some increase in the length of the column, with a narrowing of the waist and improvement in its appearance, will be produced; but there will be no visible change either in the dorsal or lumbar curve, to show that it has yielded to the stretching. Again, if the patient be requested to lean sideways, in a contrary direction to either of the curves, as if to give the spine an opposite bend, little or no change will be effected by the movement. Lastly, suppose the patient make a powerful effort to elevate her body to the utmost, she will probably succeed in increasing her height, and there will be a distinct diminution in the thickness of her waist, but the curvatures will not be straighter than before; and, it will further be noticed that, as soon as she ceases to make the exertion, the body will fall, and the waist return to its former condition. It will, therefore, be concluded that the incurvated portions possess but little mobility, while the intermediate part, where the lumbar curve ends and the dorsal begins—being the dorsi-lumbar region—possesses a greater degree of flexibility than belongs to it normally. And the reason of the excess of motion in the latter part may be easily understood. The vertebræ in that intermediate situation, from not having undergone the same changes in their relative positions which have occurred in the curved parts, have retained their mobility. Accordingly, as the portions both above and below have become comparatively rigid, it will follow that, in every extensive and powerful movement of the trunk, an undue impetus will fall on the part which has the greatest flexibility. Consequently, the structures of the joints of the intervening region will be overstrained, and it will acquire increased freedom of motion. When the writer was engaged in preparing by dissection the specimen from which the drawing for Fig. 416, p. 858, was chiefly composed, he was led to observe how great a contrast existed between the stiffness in the lumbar and dorsal curves, and the looseness and mobility in the dorsi-lumbar region.

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* The following is a remarkable example of the influence of a slightly disturbing cause in changing the shape even of solid structures during growth. A woman twenty-one years of age had been burnt in the neck when five years old. A broad cicatrix had the effect of drawing the head toward the sternum. But the interesting circumstance in the case was, that the lower jaw had become deformed in a peculiar manner, under the influence of the contraction of the cicatrix. The posterior portion of the jaw, subject to the masseter, temporal, and other muscles, preserved its natural form and position; so that the upper and lower molar teeth met when the jaws were closed. But the anterior or mental portion had been drawn down, in a curve, to such a degree, that the incisor teeth contained in it were separated by the distance of an inch from those of the upper jaw. The front teeth in the lower jaw were also placed horizontally instead of vertically. It was observed that the adhesions of the cicatrix to the subjacent parts were loose. (Case related by the writer, *Trans. Path. Soc.* 1849–50, p. 241.)

In Torticollis, commencing in childhood, it may be remarked that at adult age, the side of the head which is twisted obliquely downwards, between the shoulder and sterno-clavicular joint, is less fully developed than the other turned upward.

Diagnosis.

Angular deformity—The only deformity within the bounds of the spine and chest, with which lateral curvature is liable to be confounded, is angular projection of the vertebræ consequent on caries. If the disease which causes the formation of the angle be seated in the dorsal region, the ribs attached to the column on each side are a bar to the spine bending sideways; but when the disease is lower, especially in the dorsi-lumbar region, there may be a slight deviation to either side, and the angular may then present some of the appearances characteristic of lateral curvature. The principal distinguishing feature between them, so far as the deformity is concerned, is that contortion of the spine is an invariable accompaniment of lateral curvature, and is never present in angular; and as the signs of that twisting movement in the former are always recognised with ease, there ought to be no difficulty in perceiving the distinction. See article on Diseases of the Spine, vol. iv. p. 111.

Rickets.—The etymology of this term would lead to the supposition that it was applicable to diseases or deformities of the spine (*ῥάχις*), of all various kinds. But by common usage it is now exclusively employed to denote a particular disease of the osseous system, in which not only the spine, but the bones of the skeleton generally, are affected. However, the meaning of the name would appear to have had some influence in causing the opinion to be long entertained that the formation of the curves in lateral curvature was dependent on a morbid change in the bones, allied in its nature more or less intimately to that in rickets. But as females are peculiarly prone to be affected with lateral curvature, and as a deformed and contracted condition of the pelvis, especially dangerous in child-birth, is a common consequence of the softening of the bones characteristic of rickets, it is important to determine whether there be any foundation for the opinion. And numerous reasons are opposed to it.

1. Rickets is essentially a disease to which children of early age are subject; but the period of life at which lateral curvature begins, is from ten to fourteen. 2. Males and females are affected in equal numbers by rickets; females are most frequently the subjects of lateral curvature. 3. Rickets is most prevalent in the poor; lateral curvature in the rich. 4. Rickets is a positive disease; in lateral curvature the health is undisturbed. 5. In rickets, the bones of all the body are either incurvated, or they show some other indication of a generally prevailing disorder—the spine and ribs are included, but so are the bones of the lower extremities—and the latter are commonly more distorted than the spine: in lateral curvature, on the contrary, the spine is incurvated and the ribs distorted; but the ribs are distorted only as a consequence of the spine being curved; whence the spine is really the only part primarily curved, all the rest of the skeleton being normal.

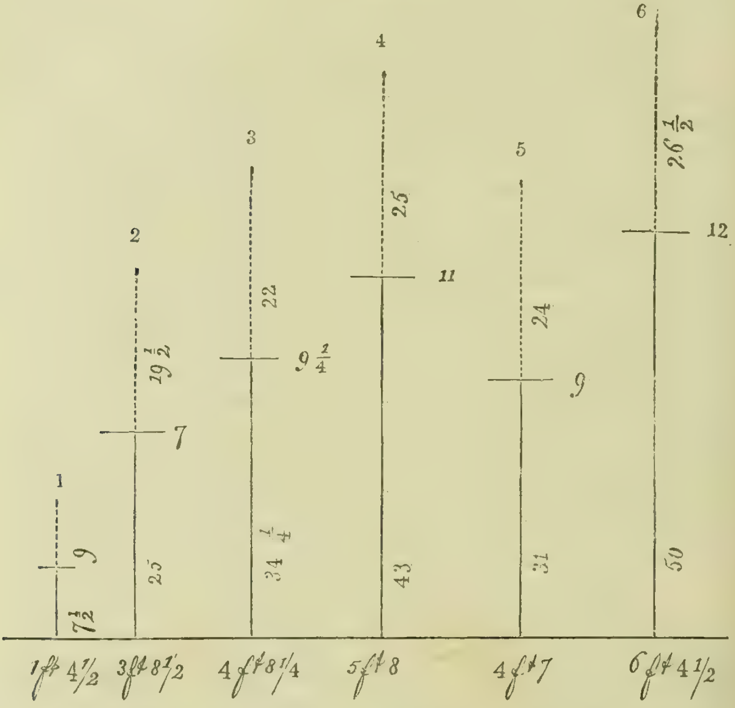
There remains another diagnostic sign. It relates to certain distinctions in the configuration of the adult frame. But to be understood, some preliminary explanation is required.

Rickets, it has just been stated, is a disease of early childhood, affecting both sexes equally. The usual period of its attack is between three and five years of age. It varies in its severity, as well as duration, in different cases; but its most general characters are—visceral derangement, with impaired nutrition, degeneration of the structure of the bones, chiefly marked by deficiency in the quantity of hardening material, and distortion of all the skeleton consequent on the morbid condition of the osseous system.

When the disease has run its course, within a period perhaps of one or two years, the patient will be restored to perfect health; but the deformity will remain; and he will bear the marks all his life, in the incurvation of the principal columnar bones, of his early illness. After, however, his growth has been completed and he has arrived at adolescence, an additional and different kind of change in his figure will be perceived. It will be observed that, independently of the curvatures, there is a deviation, in his configuration generally, from the standard relative proportions of the adult. It will be seen, in short, that he has failed to outgrow the child's form, and to change it for that of manhood.

To understand this subject, it is required, first, to keep in view the distinction which exists in the general conformation of the infant's frame, as contrasted with that of the grown-up person; and secondly, to consider what effects will be produced upon the figure, on the assumption that the growth is retarded or arrested during the active stage of rickets.

FIG. 420.



No. 1, relative proportions of upper and lower divisions of child near birth. The upper dotted line, in all, gives the length from vertex of head to crest of ilium; the lower bold line, from crest of ilium to ground; and the transverse line, the breadth of the pelvis. No. 2, at eight years of age. No. 3, seventeen years. No. 4, adult. No. 5, adult, stunted by rickets. No. 6, person of lofty stature. The measurements were taken according to a scale of one-twelfth of an inch to one inch.

In the sequel it will be seen that the enquiry embraces the form of the head, as well as the proportions of the whole body. When considering the latter, which may be taken first, it will be convenient to distinguish the upper division,—consisting of the head, the trunk (down to the pelvis), and the upper extremities,—from the lower,—consisting of the pelvis and inferior extremities.

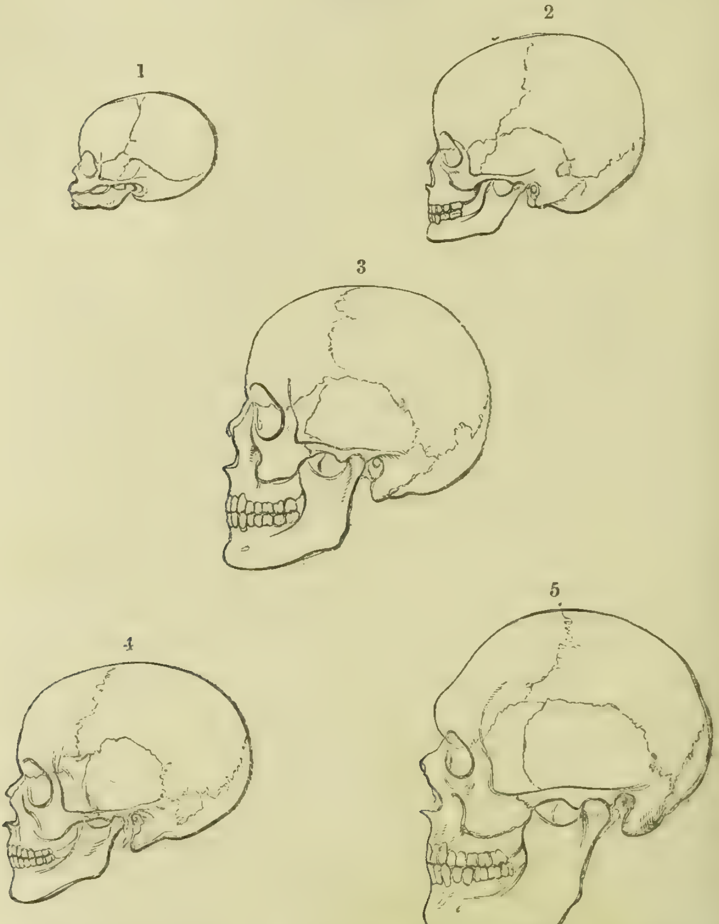
On comparing the form of the infant's frame with that of the adult, it will be perceived that the conformation of the former has relation to the act of parturition; while that of the latter has relation to man's erect position and his locomotion on the lower extremities. The adaptation of the figure of the fœtus to the process of delivery is exhibited at an early period of gestation. It is owing to the head of the young embryo being preponderatingly large compared with the nether extremity, and to the short and thick umbilical cord being attached to the smaller end, that the head falls into its place, from the beginning, over the orifice of the uterus, as it has to be expelled eventually the first. Again, while the bones generally, during fœtal life, enlarge at about an equal rate, the pelvis is kept in check, and is exceptionally small at the period of birth—a provision obviously designed to prevent the circulation in the umbilical cord from being stopped by pressure; which would occur if the pelvis were large, and blocked up the pelvic canal of the mother after the head had been delivered. But the newly-born baby, with its bulky upper, and diminutive lower quarters, is incapable of keeping its feet either to walk or stand; and it must creep on all fours. Accordingly, the proportions of the frame are reversed in the adult. The upper division—head, arms, chest and abdomen—are small, light and easily carried; while the lower division—the pelvis and lower extremities—are massive, strong, and calculated for supporting and transporting the superstructure.

If it now be supposed that, while the childish frame is passing through this revolution in its proportions, in accommodation to new conditions, an attack of rickets should intervene, causing a temporary interruption of the growth, it is obvious that the stoppage will have the effect—as will be seen at adolescence—not only of stunting the individual in size, but of marring the proportions of his figure, by interfering with the fulfilment of the changes which ought to be wrought in the relative dimensions of the members of his body. He will present, when arrived at manhood, some of the appearances characteristic of childhood. Accordingly, the person of an adult rickety individual is observed to be diminutive throughout; his stature is short, even allowing for the loss of height from the incurvation of his bones; his head is large; the trunk also is large; but the hips are narrow, and the legs short.

And the converse of what has been stated is true. If the growth of the frame has been over active, so that the natural changes have been carried to excess, as witnessed in uncommonly tall individuals, the proportions of the adult will be brought out to an exaggerated degree. The upper division—head, chest, abdomen, spine—will be relatively small, short, and light; while the lower—pelvis and lower limbs—will be inordinately broad, massive, and long.

In the head, as intimated above, analogous changes in the relative dimensions of the cranial and facial divisions, occurring between birth and adolescence, may be observed; and they are subject to be modified by differences in the rate of growth in the same manner as in the whole frame. The peculiarity which principally characterises the form of the child's head—apart from the fat chubbiness of the cheeks—is the small, contracted size of the face contrasted with the capaciousness of the cranium. Now, the subsequent increase of each of these two divisions is regulated by a distinct and appropriate influence. That which determines the growth of the cranium is the development of the brain; this important organ is distinguished for the early period of life at which it arrives at perfection; it has nearly attained its full size about seven years of age, and its increase subsequently is so slow and slight that its development may be said virtually to cease about fourteen. As the cranium therefore grows *pari passu* with its contents, it comes to maturity at the same speedy rate. The case, however, is different with the facial division. The influence which guides its growth is the development of the organ of mastication in particular. The toothless gums of the infant are adapted to the mode of its being fed by suckling. But in proportion as the two sets of teeth emerge in succession, the jaws, which had been remarkably small at first, commence to enlarge, and they go on progressively increasing till they become relatively of great magnitude. And it is not the maxillæ alone which grow in conformity with the teeth; the adjoining processes and surfaces from which the powerful muscles that move the lower jaw take their origin, consentaneously enlarge. Again, this active course of development in the facial division is continued for many years after that in the cranial has come to a standstill; it does not stop till adolescence; steadily and perseveringly, therefore, the former has been making advances, in point of dimensions, upon the latter. It is accordingly found that the facial division, in the adult, has a much larger relative size than in the child. But if it be supposed that, while that change is being effected, a stoppage of the growth for a considerable period, as by rickets, should intervene, it is obvious that the part which ought to make the greatest progress will appear to suffer most. Hence the facial division is always observed, in the individual affected with rickets, to be relatively smaller than the cranial; so that while the latter seems of average natural size, the jaws, both upper and lower, are peculiarly diminutive, and the prominences of the face corresponding to the frontal sinuses and cells of Highmore are imperfectly expanded. And

FIG. 421.



No. 1, skull of infant at birth. No. 2, skull at about six years of age. No. 3, normal adult skull. No. 4, skull of adult rickety person. No. 5, skull of Byrne, whose skeleton is in the College of Surgeons, and whose height was eight feet.

here it may be noticed, in reference to this contrast, that the forehead—the supposed special seat in the brain of the intellect—is particularly prominent, and appears remarkably capacious, in most persons deformed by rickets; and the appearance is not unfrequently regarded as a sign of superior mental quality in the individual who exhibits it; but the evidence of the callipers will show that no real enlargement of the cranium exists; and it will be concluded that the prominence and expansion of the frontal region only appear great, because the face in juxtaposition is abnormally little.

Let it be supposed, on the other hand, that the rate of growth has been accelerated, it may be expected that the relative proportions of the two divisions of the head will be the reverse of those seen in the head of the rickety individual. As the configuration of the latter bore distinct traces, in the large cranium and small face of the pristine form of the child, the configuration in a person whose growth has been carried on at an ultra rapid speed, as for example in an individual of gigantic height, will present the signs of the adult form in an exaggerated degree. The principal additions will be observed in the facial division; the upper and lower jaws will be greatly enlarged, the cellular compartments in the bones of the face, which, at the same time that they are appendages of the vocal organ, contribute large surfaces exteriorly for the attachment of muscles, will be expanded; and the result will be that while the cranial division has remained relatively stationary and small, the facial will have acquired extraordinary bulk. Further, it will be perceived that the frontal region, instead of being broad and prominent, as in the rickety skull, will appear shelving and low. That condition, however, is a consequence merely of inordinate increase in the size and expansion of the frontal sinuses.

As the frontal sinuses assist in modifying the form of the forehead, they have a remarkable influence also, in common with their allied cavities in the upper maxillary bones—the cells of Highmore—of keeping the orbits (both of persons in whom the growth has been interrupted, and in whom it has been over active) of a uniform size. When the eye-ball, the chief occupant of the orbit, has completed its growth, at a comparatively early age, the other contents likewise attain their full size, and they do not vary in bulk afterwards; hence the cavity may continue of the same dimensions throughout life. Now, it is found that the orbits, thus adapted to their contents, remain constant in capacity equally in skulls distinguished for the smallness and for the great magnitude of their facial divisions. To verify this, measurements were made of the orbits in a numerous set of skulls, which differed from each other in the relative dimensions of the bones of the face, according to the diversity of the rate of growth. These measurements were taken along the lines of the several diameters, longitudinal, transverse, and antero-posterior; and the results showed that their lengths were the same, with scarcely any appreciable difference, in all the skulls. The explanation of the uniformity is obviously as follows: the frontal cells are situated over, and the maxillary cells under, the orbits; so that the floor of the former is the roof, and the roof of the latter the floor, of the respective orbits. Again, these cells are either imperfectly developed, or developed to a great extent, according as the growth of the individual has been below or above the average rate. Being of diminutive capacity in the skulls of persons stunted in their growth during childhood—as in rickety individuals—the cells occupy a small space above and below the orbits, and the cavities of the latter, therefore, retain the standard dimensions; but being, on the other hand, of large capacity in the skulls of persons whose growth has been abnormally active, as in tall overgrown individuals, the cells encroach, as it were, by their magnitude on the walls of the orbital cavities, and subdue them to the standard dimensions.

Reverting now to the subject of diagnosis, and the question whether lateral curvature depends on a morbid condition of the osseous system identical with or analogous to rickets, for its origin, it may be alleged that the opinion derives no support from the preceding observations. Evidence is altogether wanting to show that, while the curvatures of the spine—which are the only apparent effects of the supposed softening of the bones—are in the course of forming, there is any arrest of the general growth like what takes place in the deformity from rickets. Independently of the changes consequent on the incurvations of the spine, the relative proportions of the figure are natural; the lower extremities are developed to their full extent, in length, breadth, and weight; and in the head there is a proper proportion between the cranial and facial divisions.

What chiefly makes it important to decide the question whether lateral curvature really depends on a softening of the bones, such as that to which rickets gives rise, is the consideration of the condition of the pelvis in a female patient. When rickets invades the osseous system, the most formidable effect it produces is deformity of the pelvis, the circle of bones through which the child is propelled in the act of parturition. But it has been formerly stated that, among persons affected with lateral curvature, the proportion of females so greatly exceeds that of males that the deformity might be regarded as almost peculiar to women. Accordingly, if lateral curvature be supposed to be a consequence of rickets, the inference will be drawn that all female patients so deformed will have been exposed to the danger of having their pelvis also deformed.

In his work on *Distortions of the Spine*, Mr. John Shaw opposed the view that either rickets or any analogous morbid affection of the osseous system had any share in causing lateral curvature. And he stated his opinion, founded on the examination of numerous specimens of distortion preserved in different collections, that the pelvis would not be found deformed, unless there were evident signs of the bones of the lower extremities, especially the tibiæ and fibulæ, which bear the greater amount of the pressure of the superincumbent weight, having become incurvated.*

But the preceding observations have shown that, although degeneration and softening of the osseous system, with consequent incurvation of the columnar bones in particular, are prominently marked features of rickets, yet that they are not the only important ones which characterise it or bear upon the question of the condition of the pelvis. It has been seen that, owing to rickets being a disease of childhood, and its checking or stopping the growth, it prevents that change in the relative proportions of the frame, by which the figure of the child—independently of bulk or stature—is distinguished from the figure of the adult, from being fully carried out. Now, the interruption tells with especial effect on the pelvis. No part in all the skeleton undergoes such a great transition, from being relatively small to being relatively large, between the two epochs of infancy and adolescence, as that girdle of bones. When the growth, therefore, is arrested, it is to be expected that the pelvis will be diminished in bulk throughout its whole extent, in proportion to the rapid rate at which it would have increased but for the stoppage. Accordingly, by measuring several pelves of skeletons deformed from rickets, and others of sound structure, and then comparing them, it was ascertained that the number which represented the average of the united measurements in the rickety pelves was five and a half, while that representing the normal pelves was seven. And the inferiority of the pelves deformed from rickets in their general dimensions, shown by the above numbers, was manifested likewise, as might have been anticipated, in the pelvic canal, the diameters of which, both at the inlet and outlet, were correspondingly narrow.

Hence, it may be perceived that when a patient affected by rickets in childhood, has reached womanhood and is in child-birth, she is subject to difficult labour from two distinct conditions of the pelvis, namely: 1, irregular contraction of the pelvic canal, from the softening and deformity of its walls; 2, narrowness of the canal, from defective growth of the walls.

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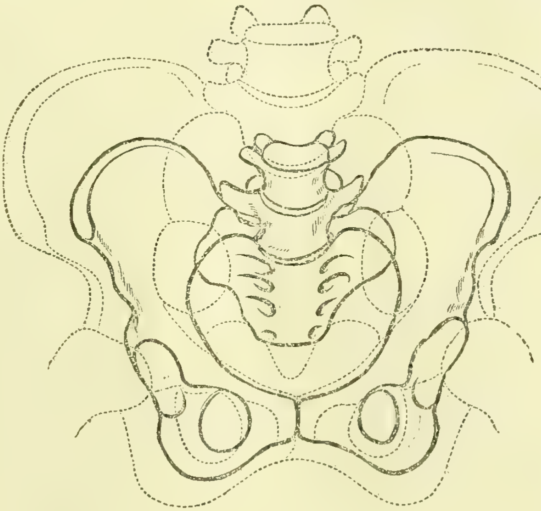
* It had been assumed, in a work of authority published a few years previously, that general softening of the bones preceded the formation of lateral curvature; and the practice which then prevailed of treating cases of the deformity by the employment of heavy iron supports, resting on the hips, was condemned, because it was considered that they gave rise, by their weight and compression, to deformity of the pelvis. See *Lectures on the Bones and Joints, delivered before the College of Surgeons*, by James Wilson, 1820.

The figure in the woodcut, representing a normal pelvis in dotted outline, was drawn on scale, from one taken from the body of a full-sized healthy female. The figure in bold outline, a pelvis of small size, represented for comparison as if placed within the bounds of the other, was drawn on scale likewise, from one removed after death from a woman whose body, both in its general configuration and the distortion of the limbs, showed unmistakeable signs of rickets. It will be remarked that few and slight traces of deformity are perceptible in the pelvis of the rickety patient; yet her death took place in child-birth from difficult labour; embryotomy had to be performed, and she died in a few days afterwards from the effects. It appears, therefore, evident, on looking to the diminutive size of the pelvis, that the main obstacle to the passage of the child's head, in this case, was caused by the imperfect expansion of the canal, consequent on defective growth.*

FIG. 422.



Prognosis.—In anticipating the issue of a case of lateral curvature, it should be remembered that the flexibility of the spine, in youth, diminishes yearly. Now, as the greater the flexibility, the greater is the proneness of the deformity to get worse if neglected; and as the greater the flexibility also, the more favourable is the condition of the spine for effecting a cure, it follows that an early commencement of treatment is urgently necessary, both for preventing increase of the curvatures, and for rectifying them. Again, as rigidity of the column increases with years, curvatures of old standing are less likely to become worse than those of recent formation; and, for the same reason, the prospect of success from treatment is more distant in them.

Lateral curvature of the spine in a young girl, however slight, ought always to be regarded as requiring immediate care; the patient ought not to be left to the chance of her 'growing out of it.' When the column leans habitually, even to a trifling degree, to one side, the superincumbent weight ceases to be supported in the line of the vertical axis, and falls chiefly on the oblique processes of the side to which the patient inclines; these rapidly undergo absorption, and in proportion as they are diminished, the curvature gets progressively worse.

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* Patients deformed from rickets, and in whom the pelvis is really narrow, are often noticed to be broad across the hips. That appearance is due to the head of the femur being sunk below its proper level, and the trochanter major relatively elevated, and there is commonly combined an arching outwardly of the upper portion of the thigh-bone. See two Papers on Rickets, by the writer of this article, in the *Med.-Chir. Trans.* vols. xvii and xxvi: also others on the same subject, in the *Lond. Med. Gaz.* for 1835, pp. 45, 349.

Owing to the spine at the lumbar region possessing greater flexibility than at the dorsal, a curve situated in the former is more easily rectified than one in the latter. On the other hand, from the dorsal vertebræ being encumbered by the ribs, which early participate in the distortion, the difficulty of overcoming a curvature there is increased. Moreover, in extending the column, a better purchase can be obtained for mechanically operating on the lumbar than the dorsal curve. Furthermore, it has been shown that, in consequence of the rigidity of the dorsal portion, absorption of the compressed vertebræ proceeds with great activity, so that the curve tends to be rapidly aggravated.

For testing the stability of the spine and judging of the efficacy of the treatment, the best mode is, first, to put the patient's body on the stretch by extension and counter-extension; then, to measure the height at its fullest, with accuracy; when that has been done, let her lounge at her ease for some time; lastly, let her height be measured after the spine has had time to sink down ; the loss observed on comparing the two measurements will indicate the strength or weakness of the column.

Treatment.—By reclining in the supine position on an inclined board, the head and armpits being adequately secured to prevent the patient from sliding down, and the lower part of the body left loose, or with some mechanical appliance added to increase the traction, extension and counter-extension may restore the spine, more or less effectually, to its straight position. The benefit anticipated is, that, in course of time, when the vertebræ and connecting structures have been kept sufficiently long in their approximately normal situations, they will become reinstated in them by the influence of growth.

It cannot be doubted that this plan of keeping a patient confined on the back for a long period would prove more efficacious than others. But there are sundry objections to adopting it, especially as an exclusive mode of treatment; the chief of these are, the injury to the patient's health, which would probably follow the prolonged confinement; the debility of the muscles that would ensue from want of exercise; the comparative seclusion; and the interference with the pursuit of education. Accordingly, it has been a constant aim to find a fitting substitute in spinal supports of various kinds. One of the chief recommendations of these is, that they allow liberty to the patient to walk or sit at pleasure, in common with others; and for that advantage she willingly submits to the irksomeness of wearing them. But their efficacy is not to be relied on. The endless variety of apparatuses of the sort invented, tried, and abandoned, shows the difficulties and disappointments connected with them. The main obstacles to applying mechanical supports successfully, proceed from its being impracticable to accommodate the rigid materials composing them to the flexible and yielding form of a young person. Whatever ingenuity may be exhibited in the construction—in forming a secure point d'appui at the hips—in introducing contrivances to hoist up the column, or to unbend it—inserting props for strength, or compresses to push the gibbous ribs inward—it is liable to fail; because, while the metallic instrument retains one unchangeable form, the compressible, flexuous body, encased within, is incessantly varying its position and shape. The remark applies particularly to cases of incipient distortion, when the patients are about fourteen years of age. Later in life, when the vertebræ and ribs are more consolidated, a better purchase can be obtained for the centres of bearing. But when that time has arrived, the curvatures have become too stiff and unyielding for treatment of any kind to be serviceable.

Physical exercises are essential adjuncts of the treatment. They accomplish various beneficial objects; besides their common use in strengthening the muscles, and preserving the health, they have the indirect effect (see

p. 857) of increasing the density and solidity of the bones, and adding to the tenacity and power of resistance of the ligaments of the joints. Moreover, they may be made available for stretching the contracted parts in the concavities of the curves; and by loosening the connections of the vertebræ, they will give greater facility to straightening the column by extension. But it would be vain to suppose that exercises by themselves could effect a cure. They can only be serviceable as auxiliaries.

It appears, that in order to do most justice in the treatment of cases of lateral curvature, the best course is to combine in various proportions, according to the nature of the deformity, and the age of the patient, parts of the three different plans briefly described. In a certain set of patients, remarkable for the weakness and suppleness of their frames, it is obvious that stiff and heavy spinal supports would not be applicable, and a preference would be given to employing the method of reclining on the inclined plane—looking forward to the patient becoming, ere long, stronger, and capable of wearing corsets of simple construction, to diminish the period of confinement on the board. Again, in every case, it ought to be considered a necessary addition to have proper systematic exercises, of the nature of callisthenic or others, regularly performed daily. Experience shows, that when the time of reclining on the plane is broken into at due intervals, by active exercises, indoors and out of doors, the health, instead of being impaired, decidedly improves under the conjoint treatment.

It might, perhaps, be thought that some detailed description should be given here of various kinds of extending-beds, apparatuses for exercises, corsets, and sundry other equipments used in the treatment of lateral distortion. But an account of them would occupy much room; and without numerous diagrams, inconsistent with the scheme of the present work, it would scarcely be intelligible. Information concerning them must be sought in books which treat specially on the subject.

Pigeon-breast Deformity.

This distortion consists in a protuberance of the sternum and cartilages, by which the antero-posterior diameter of the chest is disproportionately enlarged, and a gibbosity produced. Corresponding to the line of junction of the cartilages to the ribs, a sulcus on each side forms a boundary to the projection. The deformity is not inconsistent with symmetry in other parts of the chest, and the frame generally. It is equally common in both sexes. When confirmed, the heart and lungs are somewhat altered in relative position in adaptation to the figure; but their actions are not perceptiby deranged. The deformity is more frequently observed in the young, from six to twelve years of age, than in adults; which leads to the inference that patients commonly outgrow it.

Causes.—The writer has not found, in any work treating on the subject, a satisfactory explanation of the mode in which pigeon-breast deformity is produced. A view that appears to solve the problem was suggested to his mind when observing the movements of the chest in a child labouring under dyspnœa with impending suffocation, and for which tracheotomy had to be performed. The patient had previously a flat chest, of ordinary shape. By the stethoscope it was ascertained that scarcely any air entered the lungs. What chiefly attracted notice was the imperfect manner in which the thorax underwent expansion at each act of difficult inspiration. The clavicular and upper sternal regions were protuberant and fixed; the respiratory movements were confined to the lower three-fourths of the thorax. But instead of the ribs which moved dilating to their full extent when inspiring, their sternal ends were drawn inward. And as that sinking took place along the line of junction of the costal cartilages with the ribs, from the third or fourth downward, and chiefly near the lower margins of the chest, a depression of the antero-lateral regions was the result. Now, the appearance thus presented resembled so greatly the falling-in of the ribs, and protrusion of the sternum, seen in pigeon-breast deformity, that the conditions seemed identical. The constriction disappeared at each act of expiration. Thus, contrary to normal breathing, a partial contraction of the thorax occurred at every inspiration and a partial expansion at every expiration. Similar phenomena have been frequently observed since.

Taking into view the great flexibility of the walls of the chest in childhood, it may be understood how they should be subject to imperfect expansion, in the manner described above, when the air, through any cause, is prevented from fully distending the lungs. In the act of inspiration two distinct operations are performed: first, to create a tendency for a vacuum, the thorax is expanded; next, the weight of the atmosphere causes air to enter the lungs. By the free admission of that air into the interior a balance is established between the pressure of the atmosphere on the outside, and that on the inside, of the chest; consequently, although the parietes may be thin and pliant, their movements can be performed with perfect facility. But quite a different state may be expected when the expansion of the chest is unaccompanied with a corresponding dilatation of the lungs. For example, in the case of a child whose larynx is closed so as to impede the entrance of air, it is obvious that, if the thoracic walls could be expanded, there would be nothing to counterbalance the weight of the atmosphere without. In such cases the chest is incapable of being expanded, or it is expanded imperfectly. To the best of their ability the intercostal and external accessory layer of respiratory muscles elevate and widen the area included within the sphere of the ribs; the diaphragm also acts on the free margin of the chest, downward and concentrically, to increase the vertical diameter; but the pressure of the atmosphere interferes with their effect. And that pressure from without tells mostly on the weakest parts of the compages. These are, unquestionably, situated in the line of junction of the costal cartilages with the ends of the ribs. Accordingly, it is there that the chest is principally indented; and this indentation leads to the sternum being abnormally protuberant.

Taking these observations into view, they show that, when the chest, as in childhood, is highly flexible, any cause that obstructs the entrance of the air into the lungs may lead to changes in its figure resembling pigeon-breast deformity. In the example which has been given, the source of the difficult breathing was of a kind to threaten life. But it can be conceived that a cause acting in a similar manner, yet of relatively slight importance as regards health, might imperceptibly, and after a considerable lapse of time, bring about an identical condition of the chest. If a child suffer from chronic enlargement of the tonsils, the encroachment of the glands on the glottis may diminish the calibre of the tube to such a degree that the air will enter with difficulty, so as to fill the lungs incompletely; and the long continuance of the dyspnœa thus produced may lead eventually to the chest becoming of the pigeon-breast shape. This idea is supported by a remark of Dupuytren's, that patients with this deformity are frequently found to have suffered at one time from enlarged tonsils.* The writer had under his care a boy, three and a half years old, in whom both tonsils were so large that they gave rise to dyspnœa, aggravated at nights so as to threaten suffocation. The air entered the lungs imperfectly; and it was remarked that the front of the chest was gibbous. The glands were almost beyond sight, having been propelled downward, as it appeared, from getting within the grasp of the constrictors of the fauces. Some days after a partial excision, the patient nearly expired in a fit of suffocation, and was restored by tracheotomy. Subsequently the tonsils were effectually removed, and the patient perfectly recovered. It was then particularly noticed that the front of the chest subsided to its natural level, and that all appearance of deformity was effaced. Further observations may, perhaps, show that other morbid changes, capable of interrupting the entrance of air into the lungs, have the effect of producing the gibbosity.*

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* *Répertoire d'Anatomie et de la Physiologie*, tom. v. p. 112.

Treatment.—Having stated that pigeon-breast deformity exhibits a tendency to spontaneous cure, it may suffice to refer briefly to certain measures which will, perhaps, assist Nature in her work. A truss, like that worn for umbilical hernia, has been found of service; or the patient, in addition to wearing the truss, may be directed to lie for several hours daily, at divided times, flat on his back, having a bag of shot, of suitable weight, laid on his breast. Most benefit, however, is to be anticipated from athletic games; and rowing may be specially mentioned.

ALEXANDER SHAW.

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* See a paper on 'Deformity of the Chest from Dyspnœa,' by the writer, in *London Med. Gaz.* Oct. 1841.

APNŒA (ASPHYXIA).

From Suffocation, Hanging, Drowning, Chloroform, Poisonous Gases, &c.

AS the chief characteristic of the mode of dying about to be considered is the continuance of the heart's action after the cessation of the respiratory process, in order to be logical as well as philosophical in the treatment of the subject it is necessary to abandon the old and familiar word Asphyxia, which, in its etymological sense, signifies an absence of pulse (*ἀ, not*; *σφύζω, I beat*), and employ in its stead the more suitable term Apnœa (*ἀ, not*; *πνέω, I breathe*). Even the word Apnœa fails clearly to convey to the mind the true proximate cause of death; for in certain cases of suffocation animal life is extinguished, although there be no impediment to the physical part of the respiratory process, and in these circumstances it is not the absence of the respiratory act, but of the proper respiratory medium (oxygen), which determines the death of the individual. As the word apnœa is, however, applicable to the majority of cases, we prefer to retain it rather than coin a new one, which, in its turn, might be found equally inadequate to the explanation of phenomena which advancing science may afterwards reveal.

So long as animal life continues, the function of respiration knows of no intermission. By day and by night, sleeping and waking, the lungs are ever performing their allotted labour of inhaling fresh and expelling effete air.

The term 'apnœa' therefore clearly defines the great truth that without respiration there is no life: man's earliest declaration of independent existence being his first respiratory effort; his seal to the abdication of life, his last expiratory act.

Few are aware how little the respiratory function is under their own control. At the first glance many might imagine that respiration is, to some extent, a semi-voluntary process, for they can temporarily arrest it at pleasure. If, however, the time men are able to cease respiring be exactly calculated, no one can fail to be astonished at its extreme brevity. Not one in a hundred can cease breathing for a single minute without suffering great discomfort; and still fewer can hold their breath for two entire minutes without yielding to an involuntary and irresistible respiratory effort. The numerous stories heard and read of persons voluntarily holding their breath for five or more minutes are simply fables. Farther on it shall even be made apparent that the numerous reports of successful cases of resuscitation after prolonged submersion — such as half-an-hour, for example — are pure impossibilities, originating in imperfectly-observed data. Such statements would never have been promulgated had their authors for a moment considered how frequently repeated and uninterrupted the acts of respiration are. The number of respirations is alone a sufficient proof of their necessity. If, for example, the average number of respirations be taken as low as eighteen in a minute, which is somewhat under one in four seconds, it is evident that the gases essential to the continuance of organic life are renewed one thousand and eighty times in a single hour — figures which are of themselves sufficient to indicate how perilous must be even a very temporary cessation of the respiratory function. Shortly, however, other reasons will be adduced for disbelieving the statements referred to. Meanwhile it may be proper to consider the

SYMPTOMS OF APNŒA.

The first symptoms that manifest themselves when a healthy person is deprived of air are feelings of thoracic fulness and discomfort, which gradually, but rapidly, assume the form of an intense oppression. To the latter symptom is soon superadded an uncontrollable desire to breathe, which is immediately followed by violent respiratory efforts. The respiratory efforts are at first short and recur in rapid succession. They soon become deep, forcible, and prolonged, with a gradually-widening interval between them until just before they entirely cease, when they again diminish in force and duration. During this period, which, for the sake of convenience, may be termed that of respiratory movement, certain cerebral symptoms present themselves in somewhat of the following order: In the earlier part, the patient feels a sensation of fulness in the head and giddiness; experiences singing in the ears, and has flashes of light dancing before his eyes. To these, it is said by persons who have been rescued from impending suffocation, succeed pleasing, almost voluptuous, dreams, which however, soon fade away, and give place to insensibility and unconsciousness, which, in their turn, are speedily followed by convulsions and coma.

As regards the circulatory system, it is found that at first the heart's action is accelerated, partly perhaps on account of the patient's struggles for breath. This condition is but transitory; for in the space of a very few seconds its action becomes slow, laboured, and feeble, till the pulse at length ceases to be perceptible at the wrist. The heart is, however, still pulsating, and the throb may be detected by the aid of the stethoscope: the action gradually becomes less and less distinct, till it entirely ceases at a period within ten minutes after the first interruption to the respiratory process. The period that elapses between the last respiratory effort and the cessation of the heart's action may be calculated to vary from two to four minutes.

The appearance of the patient during the time just described undergoes a marked change. There is an extremely anxious expression of countenance, blueness of the lips, projection of the eyeballs, distension of the vessels of the face, head, and neck, frothy mucus, occasionally sanguineous, about the mouth, an involuntary passage of urine and fæces, sometimes even an emission of semen with or without erection. All of these symptoms are modified, and supervene with more or less rapidity, according to the mode in which the apnœa has been produced. Although apnœa may be induced in a great variety of different ways, each of which presents its own peculiarity, it is unnecessary at present to dwell upon the subject, the diagnosis of the case being in general attended with no difficulty, from the fact that its history clearly explains the symptoms. It has, however, happened that the medical attendant has been purposely misled into an error in diagnosis by the relatives of the patient, who, in their desire to protect the honour of the family, have occasionally not hesitated to trifle with the life of one of its members. It is therefore of importance to call attention to the danger, which a practitioner occasionally runs in such cases, of mistaking the cause of the symptoms, and thereby falling into an error in treatment. This can scarcely be more forcibly done than by briefly relating the case recorded by Mr. Thomas Stainthrope, which strikingly illustrates the truth of the remark.

On one occasion, Mr. Stainthrope was suddenly called after midnight to see a clergyman. On arrival he found the gentleman in bed, unable to speak, insensible, and presenting the symptoms of apoplexy. The relations heard the remarks of the medical attendant, listened to the line of treatment suggested, and assisted in its performance, without giving the slightest hint to the true cause of the symptoms, or making any allusion to the fact that the patient had, a few minutes before, been found suspended by the neck to the top of his bed. Mr. Stainthrope, in the belief that the case was one of apoplexy, opened the veins of both arms, and extracted three pints of blood before any improvement in the symptoms took place. This was followed by other treatment considered applicable to the case; but it was not until ten hours had elapsed that the gentleman was able to answer questions; and no wonder, seeing that if the medical attendant had been honestly informed of the cause of his patient's symptoms, he might probably, with a little assistance to respiration by artificial means, have restored him in as many minutes. The gentleman recovered.*

Apnœa arising from disease may give origin to precisely the same train of symptoms as that supervening upon an accidental mechanical obstruction to the respiratory process; the only difference being that the symptoms in the former case usually progress very slowly, as for example, in cases of death from apnœa caused by œdema of the glottis; from the trachea becoming blocked up with a false membrane, as in diphtheria and croup; from the accumulation of mucus, as in bronchitis; from insufficient healthy pulmonary tissues remaining to admit of the blood becoming arterialised, as in pneumonia; and from compression of the lungs from effusion, as in double pleurisy.

In all these cases there is one remarkable circumstance observable, namely, that the lividity and congestion of the face are almost, if not quite, as apparent as in cases arising from a ligature round the neck, by which the descent of the blood through the jugular veins is interrupted. The same remark is equally applicable to cases in which the disease is external to the trachea; as, for example, in cervical tumours, aneurism, hypertrophied thymus, &c., which produce apnœa by their pressure on the trachea.

The explanation of this is simple enough. First, the face and lips are livid from the arteries conveying venous instead of arterial blood; and secondly, they are congested on account of the circulation being arrested in the lungs, which causes the right side of the heart and the large veins opening into it to be engorged; and these, in their turn, produce congestion in the vessels opening into them.

POST-MORTEM APPEARANCES.

The external appearances presented by individuals in cases of death by apnœa vary according to the manner in which it has been induced, as well as with the period that has elapsed between the examination and the extinction of life. If the examination be delayed for twelve hours, for example, the signs presented by the body differ but very slightly, if at all, from those frequently found in persons that have died from other causes. Positive evidence, indeed, can only be obtained in such cases by an internal inspection, and even that must be carefully made, otherwise the cause of the apnœa may escape detection. This remark is specially applicable to cases of accidental and intentional apnœa.

If the body is seen, within three or four hours after death, its external surface will be found to present numerous discolorations. The lips are blue, and oftentimes covered with frothy mucus, which occasionally presents a slightly sanguineous appearance. It ought not to be forgotten that frothy, even sanguineous, mucus may be found about the mouth in other cases of sudden death besides that arising from apnœa. This is the case in epilepsy; in heart-disease; and on the very day of writing these lines we saw it in a marked degree in a case of concussion of the brain. The driver of a pianoforte van was thrown violently from his seat against a lamp-post; and on his being brought to University College Hospital, the slightly tinged froth around the mouth and about his nostrils was specially observed. He had been dead about fifteen or twenty minutes. The tongue is often swollen and livid, and not unfrequently shows marks of the teeth upon it. This is particularly noticeable in those cases in which convulsion has preceded death. The eyelids are half open and the pupils dilated. The countenance is generally placid, the skin of the face usually pallid, or if discoloured at all, possessing a faintly livid transparency.

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* *Lancet*, Oct. 1, 1859.

In cases of death from drowning, the skin has now and then been observed to present the appearance denominated cutis anserina; but this is by no means a common occurrence.

In apnœa from the external application of mechanical means, evidences of the mode by which death has been induced generally remain visible for some hours. There may be abrasion, ecchymosis, or laceration at the injured parts. There may be the mark of a cord or of fingers upon the neck. The hyoid bone may be fractured, the cartilages of the larynx dislocated; and various other evidences of mechanical injuries, according to the manner in which the apnœa has been induced.

On the other hand, it must not be forgotten that death may arise from mechanical means, and not a trace of its nature be visible to the eye. This has frequently happened in cases of smothering and plugging of the fauces and windpipe. In such cases, therefore, the existence of the apnœa can only be detected by an internal inspection.

Even in cases of death by hanging, if the body be cut down immediately after the extinction of life, the mark of the cord or rope entirely disappears within a very few minutes, so that a person examining the body for the first time half-an-hour or more after death, would fail to discover any traces on the neck indicative of the manner by which life was extinguished. This arises from the fact that where there has been no excessive application of violence the mark of the cord is due (contrary to the common idea) to the post-mortem constriction; so true, indeed, is this, that if a human body be suspended by a cord immediately after death from ordinary disease, and allowed to hang for more than half-an-hour, the mark of the cord becomes permanently visible. These facts ought never to be forgotten in post-mortem examinations of medico-legal import.

Moreover, the post-mortem appearances in cases of poisoning by the substances included under the head of toxic gases, vary as much as the symptoms themselves. In some they are even totally opposed. Thus, for example, while the muscular tissues and organs of an animal poisoned with sulphuretted hydrogen are of an intensely dirty-black colour, those of an animal that has succumbed to the effects of pure carbonic oxide are of the most beautiful vermilion hue. So it can be readily imagined that, even if we felt inclined, it would be impossible for us, in the short space at our disposal, to give an outline of the symptoms and post-mortem appearances produced by all the substances that might be included under this heading.

As regards the much vexed question of *Rigor Mortis,* it may be said that it usually sets in early; and this is particularly the case after drowning in cold water, when a state of semi-freezing has been frequently observed instantly to succeed, if not actually to usher in, death. So firmly are substances occasionally grasped in the clenched hand of the drowned, that they are only to be extracted from it by the application of great force. Cases are recorded where the finger-bones have been actually fractured during the forcible opening of the hand.

Condition of the brain.—The cerebral vessels have by most authors been particularly noted as being engorged with dark venous-coloured blood. Great doubts have recently been thrown on the value of this sign, however, by Ackermann, who states that from the results of experiments on animals, conducted according to Professor Donders' method of rendering visible the condition of the circulation in the brain during life, it appears that death by suffocation is always connected with an exsanguine state of the cerebral vessels; the appearances of hyperæmia, so often observed, being merely the result of the post-mortem mechanical distribution of the blood. The appearances of cerebral anæmia, the author states, are even distinguishable in cases where the animal has been strangled with a cord round its neck, and the head kept somewhat lower than its body. The anæmic condition of the brain is gradually assumed after death if the head be not kept lower than the rest of the body, and it only attains to its maximum an hour or two after death. If these assertions be correct, they clearly point to the necessity of carefully taking into consideration the position of the body after death, before drawing any conclusions from the state of the cerebral vessels.

Ackermann goes so far as to say that the condition of cerebral anæmia is equally observable after death from compression of the chest, inhalation of chloroform, and injection of water into the lungs. The results of these experiments seem to explain why cerebral anæmia has been so frequently noted in cases of death by apnœa. It must not be forgotten that extravasations of blood under the arachnoid have been occasionally found in drowned persons. These were probably due to the injuries sustained by the head in falling from a height. Mere concussion with the surface of the water has been known to produce it; and it is common enough in persons who have come into violent contact with the bottom, or substances floating on the water, while diving. In a case of death from the inhalation of chlorine gas, it is stated that the gas was afterwards detected in the fluid of the ventricles of the brain.

Condition of the heart and vessels.—Particular attention has been paid to the condition of the heart and great vessels in cases of death by apnœa. It is usual to find the right side of the organ, both auricle and ventricle, as well as the large vessels attached thereto, highly engorged with dark-coloured blood. The left side of the heart, on the other hand, is in the majority of cases found empty; or if it contains blood, the blood is of the same venous hue as that found occupying the right side of the organ. The blood throughout the whole body, indeed, is of a similar dark tint. Some state that it presents the additional peculiarity of being fluid; but this is far from being always the case. The portal system is greatly engorged. The liver, spleen, and kidneys specially partake of the venous congestion. It may indeed be asserted, in general terms, that in death by apnœa all the internal organs are more or less engorged with dark blood. Most authors have stated that the lungs are particularly so; but although we have had our attention specially directed to this point for many years past, and enjoyed several opportunities of being present at the autopsy of persons who have perished by apnœa, we are forced to admit that this is not so invariably the case as we had been led to expect.

There being no more blood in a person killed by apnœa than in one who has died from any other cause, it is easy to see that there cannot possibly be a general engorgement of the whole vascular system. If one part of the body is particularly congested, another must be proportionally anæmic. The venous system is full of blood because the arterial is empty; and the simple reasons are—1st, that the pulsations of the heart and vessels continue after the respiration and consequent circulation in the lungs is stopped; and 2dly, the resilience of the arterial coats prevents the return of the blood into them from the capillaries. Again, as regards the congestion of the internal organs. If it be very marked, there is a corresponding pallor of the external surface. This is specially noticeable in persons drowned during the winter months, and is due to the cold causing constriction of the cutaneous vessels and driving the blood inwards.

Condition of the respiratory system.—In cases of death by hanging, strangulation, and suffocation, the lungs present no characteristic appearance; unless it be that, on opening the chest, their tissue does not collapse in the usual manner, in those exceptional cases where the exit of the air by the trachea is prevented by constriction or plugging of the windpipe. In cases of death from the inhalation of sulphuretted hydrogen gas, the pulmonary tissue is blackened, and in those from carbonic oxide gas of a fine vermilion hue.

It sometimes happens when the apnœa is due to the inhalation of toxic vapours, such as chloroform, that there are one or more small extravasations of blood found in different parts of the pulmonary tissue. Sometimes these hæmorrhagic effusions are quite superficial, at others deep seated. It is more particularly in cases of death by drowning that the lungs may be said to present characteristic appearances, and to these we shall now make special allusion.

Some say that water never penetrates the lungs, in consequence of spasm of the glottis being induced as soon as the fluid comes in contact with the opening to the air-passages. Others again, with equal confidence, assert that not only water, but any foreign substance, such as mud, duck-weed, and chaff, which may accidentally chance to be floating in it, are carried into the lungs. Our personal experience, as well as that of the Royal Medical and Chirurgical Society's Committee,* entirely negative the former, and support the latter, statement.

Into the lungs of every animal, without a single exception, experimented upon by the Committee, the fluid in which the animal was immersed freely entered. The extraordinary force by which substances are drawn into the lungs in cases of drowning was estimated by the Committee, and found to be equal to the raising of a column of mercury four inches.† When dogs were drowned in plaster-of-Paris, on examining the lungs after death the white plaster could easily be detected in the minute bronchial tubes. Even in the lungs of guinea-pigs held upside down, with only the nose immersed sufficiently deep in mercury to prevent the possibility of the animal getting any air, globules of the metal were readily detected in the minute tubes, thereby proving that this weak animal's respiratory efforts were capable of drawing the mercury the distance of one or two inches in spite of gravitation. The lungs of animals drowned in pure water, when examined immediately after death, were found by the Committee to be saturated and sodden with water to such an extent that they pitted on pressure, felt doughy to the touch, were exceedingly heavy, and incapable of collapsing. The air-tubes were choked up with a sanious foam, which consisted of blood, water, and mucus, churned up with the air in the lungs by the respiratory efforts of the drowning animal. On section of the pulmonary tissue, frothy water stained with blood poured out at every point.

How can this fact be reconciled with the statement so often made, that no water is to be found in the human lungs after death by drowning? We have ourselves failed to detect water in the respiratory organs of a young woman, aged 23, who committed suicide by drowning. The lungs, when examined twenty-four hours after death, crepitated readily on pressure, except in the most depending portions to which the blood and water, if there was any, had gravitated. The failure in detecting water in this case, however, did not excite the least surprise, notwithstanding our being in possession of the above-mentioned data; for we were at the same time acquainted with the important fact of the powerful absorbing power of the pulmonary tissue. It is almost impossible to say how much water may be taken into, and disappear by absorption from, the lungs during the act of drowning. It must be remembered that the extinction of life in cases of submersion is not due to water entering the lungs, but solely to the absence of air. If air be allowed to enter the lungs at the same time as the water, the animal suffers little or no inconvenience from the presence of the latter in the pulmonary tissue. One can wash out the lungs by a continuous stream of water, and the animal yet live. It may even be all the better for the species of pulmonary irrigation. It is only during the first few minutes that water induces much irritation, and causes the animal to struggle and cough. The irritation soon subsides; and if the water is allowed steadily and slowly to flow into the lungs, no apparent inconvenience arises. Even half-an-ounce may be suddenly thrown into them, and, after causing the animal to make one or two deep inspirations, entirely disappear. This may be repeated at intervals of a few seconds for at least half-an-hour, without in the slightest degree endangering life. All that is required to insure success in this experiment is simply to allow of the admission of a sufficient quantity of air to keep up the arterialisation of the blood.

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* As it will frequently be necessary, in the course of this article, to refer to the results obtained by the Committee, it may perhaps be as well to mention that the gentlemen composing it were—C. J. B. Williams, W. S. Kirkes, George Harley, J. B. Sanderson, C. E. Brown Séquard, H. Hyde Salter, W. S. Savory, and E. H. Sieveking, Hon. Sec. Med.-Chir. Soc. (ex-officio). The report appeared in the forty-fifth volume of the Society's *Transactions*, 1862.

† Vide report, *Med.-Chir. Trans.* vol. xlv. p. 455.

We have inserted and firmly tied into the trachea of a large dog a long glass tube, to the upper end of which a glass funnel was attached, in order to enable the experimenter the more easily to pour in water; and while the animal was lying on its back, ounce after ounce of water has been thus introduced into the lungs, and from thence absorbed into its circulation, without producing any visible disturbance, except during the few seconds that the water in its transit blocked up the tube and prevented the entrance of air.

If water be, as has been already said, slowly poured into the lungs, and sufficient air at the same time admitted, thirty, forty, or fifty ounces may be easily introduced in as many minutes; and on killing the animal an hour or two afterwards, not a trace of the liquid be found in the pulmonary tissue; the lungs at the same time appearing none the worse for the experiment.

There cannot be any longer much question about water entering the lungs in cases of drowning; and its absence in post-mortem examination is due, in all probability, to its subsequent absorption. In cases of persons drowned in ponds, duck-weed and other matters floating on the water have frequently been found in the trachea and bronchi, and yet no liquid detected in the pulmonary tissue. We have observed that in an animal that has struggled much, and frequently got its nose to the surface for a sufficient length of time to inhale a little air, there is far less water found in the lungs than in one that has been from the first wholly submerged. This is precisely what happens with human beings, who, even in cases of suicide, generally struggle for some time, and thus succeed in obtaining occasional gasps of air, at last succumbing to the combined effects of exhaustion and suffocation. Again, it may happen that on removal from the water the body may be so placed as to admit of the exit of any fluid that may chance to be present in the trachea and lungs. These are points which will be more easily understood after having discussed the pathology of drowning, so that it will be better in the meanwhile to turn attention to the consideration of the

PHYSIOLOGY AND PATHOLOGY OF APNŒA.

In order to be philosophical as well as practical in the exposition of the physiology and pathology of this mode of death, it will be necessary to divide the various forms of death by apnœa into the four following classes, the subdivisions of which, for the sake of brevity, are best put in the shape of a skeleton diagram:

Apnœa, 1st, from a mechanical impediment to the entrance of air into the lungs.

2nd. From drowning.

3rd. From the absence of oxygen in the respired gas.

4th. From the inhalation of a toxic vapour associated with an absence of oxygen.

Apnœa may arise from

1st, Mechanical impediment to the entrance of air into the lungs.	Accident.	External.	Pressure on the trunk preventing the expansion of the chest; throttling; garrotting; strangulation by a cord; hanging; smothering by covering the mouth and nostrils, imbedding the face in earth, feathers, wool, &c.; paralysis of the respiratory muscles from injury to the spinal cord, or to the base of the brain; or a double penetrating wound of the chest admitting air.
		Internal.	Choking from a morsel of food or other substance blocking up the fauces; plugging of the trachea by a cherry-stone or other substance; constriction of the fauces and injury to the glottis from application of corrosive and irritating fluids.
	Disease.	External.	Pressure on the trachea from an aneurism or other tumour.
		Internal.	Œdema of the glottis; tumour on or about the vocal cords; false membrane blocking up the air-passages, as in diphtheria and croup; bursting of an abscess or aneurism into the trachea; double pneumonia or pleurisy; accumulation of mucus in the bronchial tubes; apoplexy at the base of the brain or in the medulla oblongata, causing paralysis of the pneumogastric nerve and of the respiratory muscles.
2nd, Drowning . . .			In any liquid of whatever nature—water, wine, beer, or brine.
3rd, Absence of oxygen in the respired gases.			Inhalation of pure nitrogen, hydrogen, or any other innocuous gas.
4th, Inhalation of a toxic gas or vapour.	In which death is erroneously attributed to apnœa.		Carbonic acid, carbonic oxide, coal-gas, choke-damp, ammonia, chlorine, sulphuretted hydrogen, arsenuretted hydrogen, antimonuretted hydrogen, sulphurous acid, nitrous acid, hydrocyanic acid, vapour of chloroform, ether, amylene, or any other volatile product.

Death from a mechanical impediment to the entrance of air into the lungs.—In many of the examples of death by apnœa cited in the above table, it is evident that it must occasionally happen that the death is accelerated by the direct action upon the body of the cause producing the apnœa. Thus, even in the first sub-class, which is specified as being due to mechanical obstruction to the entrance of air into the lungs, it can readily be imagined that the patient does not always succumb from pure apnœa. Fracture of the ribs, rupture of the liver, and many other injuries, may arise from pressure on the trunk, and thereby tend greatly to accelerate death. But there can be no doubt that in the majority of cases of suffocation arising from pressure on the thorax and abdomen preventing the expansion of the chest and consequent inhalation of air, apnœa is the immediate cause of death. For example, it would have been so in the case of the black athlete, who nearly lost his life in consequence of the shrinking of the plaster-of-Paris in which he was enveloped while having a cast of his body taken. The plaster shrank as soon as it began to set, and compressed the chest to such an extent that the poor man could neither breathe nor speak, and the extreme danger of his situation was only discovered just in time to rescue him from impending suffocation. In this case death would have been the result of pure apnœa.

Persons crushed in a crowd may die, in the same way, of pure apnœa, and even those accidentally buried beneath a fall of earth or stones, as well as such as are strangled with a cord, garrotted with the arm, or throttled with the hand; but in no one of these cases is pure apnœa of necessity the only cause of death. As a striking illustration, let us take death by hanging. It is known that, as a rule, the person is suffocated by the pressure of the rope on the trachea preventing the admission of air into the lungs. Occasionally it happens, however, especially in hanging at legal executions, where the body is allowed to fall from a distance with a sudden jerk, that the death is instantaneous, in consequence of dislocation or fracture of the vertebræ with an accompanying lesion of the spinal cord. The contrary may likewise occur, and instead of death being more rapid, it may in reality be slower than in pure apnœa. This may arise from the position of the rope on the neck being such as to interfere with the circulation in the jugular veins, and thereby induce an artificial apoplexy, which, by reducing the necessity for oxygen, allows the life of the individual to be prolonged beyond the limit allotted to pure apnœa. This statement will be readily appreciated after the effects of anæsthesia in cases of drowning have been explained.

It is hence evident that if we wish to study the phenomena presented in cases of death by pure apnœa, arising from a mechanical impediment to the entrance of air into the lungs, and to recognise the order of their sequence, it will be necessary to turn our attention for a few minutes to its least complicated form; and this unfortunately can only be satisfactorily illustrated by reference to experiments on animals. We must therefore leave aside, for a time, the consideration of its effects upon the human being.

The Committee of the Royal Medical and Chirurgical Society has furnished the following important data:

First, the duration of the respiratory movements.

Secondly, the duration of the heart's action.

Thirdly, the duration of the heart's action in relation to the duration of the respiratory movements.

The method of experimenting was as follows: The animal was secured on its back, and the trachea exposed by a single incision in the mesial line of the neck. A ligature having been passed round the windpipe, it was opened by a vertical cut, and a glass tube, as large as could be conveniently inserted, was passed into it for a short distance downwards, and firmly secured by the ligature. Through this tube, while patent, the animal breathed freely, but the supply of air could be at once completely cut off by inserting a tightly-fitting cork into the upper end of the tube. It was ascertained by separate experiments that the tube thus plugged with the cork was perfectly air-tight. From the results of nine experiments performed in this manner it was found—

First, that in the dog the average duration of the respiratory movements after the animal has been deprived of air is four minutes five seconds; the extremes being three minutes thirty seconds, and four minutes forty seconds.

Secondly, the average duration of the heart's action is seven minutes eleven seconds; the extremes being six minutes forty seconds, and seven minutes forty-five seconds.

Thirdly, the results of the experiments led to the belief that, on an average, the heart's action continues for three minutes fifteen seconds after the animal has ceased to make respiratory efforts; the extremes being two and four minutes respectively.

In the case of three domestic rabbits experimented upon, it was found that on an average they ceased to make respiratory efforts in three minutes twenty-five seconds; that their hearts' action stopped in seven minutes ten seconds; and consequently that the interval between the last respiratory effort and the cessation of the heart's action was three minutes forty-five seconds.

It will be here observed that there is no very marked difference either between the duration of the respiratory movements or of the heart's action in the powerfully-constituted dog and the weakly-constituted domestic rabbit. It appears, therefore, that in the absence of any positive reliable data regarding the absolute duration of the respiratory movements and of the heart's action in man in cases of death by uncomplicated apnœa, one may venture to assume that they do not differ very materially from those of the animals just cited.

The next point of importance to ascertain is the latest period at which recovery is possible after the simple deprivation of air. Here again the Committee has furnished important data, which may be usefully turned to account in considering the subject of treatment in the case of the human being.

The result of the experiments led to the conclusion—1st, that a dog may be deprived of air during a period of three minutes fifty seconds, and afterwards recover without the application of artificial means; and 2dly, that a dog is not likely to recover if left to itself after having been deprived of air during a period of four minutes ten seconds. Other experiments tended also to confirm the above fact, viz. that in dogs the doubtful interval of recovery and death lies between three minutes fifty seconds, and four minutes ten seconds.

From the results obtained by the Committee while engaged in ascertaining the exact period after the simple deprivation of air at which recovery is possible under natural circumstances without the aid of any artificial means of resuscitation, it was found possible to deduce the following conclusions, which most probably are as applicable to man as to the animals experimented upon by the Committee.

1st. That a state of apnœa being maintained for a given time, the later the respiratory efforts are continued, i. e. the shorter the interval between the last respiratory effort and the admission of air, the greater the chance of recovery.

2nd. That air being admitted at a given time after the last respiratory effort, the earlier the respiratory efforts cease the greater the chance of recovery; for the earlier they cease, the shorter the interval between the establishment of, and the release from, the state of apnœa.

3rd. In respect to the relation between recovery and the duration of the heart's action, it was found that under no circumstances did recovery ever occur when the heart's action, as indicated by a needle[*] inserted into the organ, had stopped.

Apnœa from submersion.—We have now to consider the second form of death by apnœa, viz. that by drowning. As will be immediately seen, it presents conditions differing widely from those met with in any of the forms of death just considered, arising from the mechanical obstruction to the entrance of air into the lungs.

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[*] The duration of the heart's action was conveniently ascertained by means of a long pin inserted through the thoracic walls into some part of the ventricles. So long as the heart continued to beat, the pin moved, and its motions were thus recorded for some time after the cardiac sounds had ceased to be audible. The needle may be withdrawn and reinserted several times without producing any other result than slight temporary acceleration of the heart's action.

First, as regards the length of time a person may be submerged and yet recover.

Before discussing this point in connection with the human being, it will be advisable, in order to place the subject in its clearest light, first to examine the results which have been obtained from experiments on animals, as they explain many of the phenomena occurring in man which have hitherto been regarded as obscure.

Having seen what the effects of simple apnœa are, we shall now proceed to quote the results of the experiments performed by the Committee, which illustrate the effects of drowning.

1st. When a dog was kept under water only one minute, it recovered.

2nd. When a dog was submerged one minute fifteen seconds, it also recovered.

3rd. When a dog, treated precisely in the same manner, was submerged one minute thirty seconds, it died; and this was invariably the case, even when the animal was not only able to make spontaneous efforts at respiration, but actually capable of giving a cry after its removal from the water.

Thus, then, we are here furnished with the remarkable fact, that whereas in simple apnœa recovery is always possible after three minutes fifty seconds, only one and a half minutes' complete submersion in water suffices to destroy life. To what is this extraordinary difference due?

In order to solve this question the Committee placed two dogs under precisely similar circumstances, with the exception that in the one case the free access of water to the lungs was permitted, and in the other prevented. The following were the experiments:

First. Two dogs of the same size were fastened to the same plank and submerged at the same moment, one of them having previously had its windpipe plugged in the usual way, and the other not. At the end of two minutes they were simultaneously removed from the water. The one that had the trachea plugged at once recovered; the other died.

Secondly. The above experiment was repeated, the dogs being kept under water four minutes. When removed from the water, the dog that had his trachea plugged got up in a few minutes comparatively well; while the other, though gasping when taken out, died.

These experiments satisfactorily show that the difference between apnœa produced by plugging and that by drowning is not due to submersion, to depression of temperature, or to struggles, seeing that the two animals were placed under precisely similar conditions, with this most important exception, that in the one case a free passage of air out of the lungs, and of water into them, was permitted; in the other, the exit of air and the entrance of water were alike prevented.

There can be no doubt that both these circumstances are concerned in producing the difference in the results of the two experiments. Moreover, the condition of the lungs, as revealed by post-mortem examination, appeared to the Committee to furnish a further proof that the shortness of the period of immersion, which proves necessarily fatal to an animal, is mainly due to the entrance of water, and the effects thereby produced.

On examining the lungs of the animals deprived of air by plugging the trachea they were found simply congested; but in the animals drowned, not only was the congestion more intense, accompanied with ecchymosed points on the surface and in the substance of the lung, but the air-tubes were completely choked up with a sanious foam, consisting of blood, water, and mucus, churned up with the air in the lungs by the respiratory efforts of the animal. The lung-substance too was heavy, and saturated with water.

Since the conclusion of the labours of the Committee, we have carried the enquiry a step further, and ascertained that the effects of the water extend beyond the mere pulmonary tissue. In some carefully performed experiments, we found that in cases of drowning the blood in the left side of the heart contains much more water than that on the right; and when examined microscopically, the blood-corpuscles from the two sides of the heart present entirely different appearances. Thus, for example, we ascertained that while in the blood of the right auricle or ventricle the corpuscles may be nearly all serrated, in the watery blood from the left side of the organ it is not only frequently utterly impossible to detect a single serrated corpuscle, but in the latter blood, many of the cells have swollen up, burst, and allowed their colouring matter to escape, and stain the serum of a deep red colour. In some cases we also noticed that occasionally, when there was scarcely a whole blood-corpuscle to be seen, the field of the microscope was occupied by an immense number of small bodies like escaped nuclei, and we are not yet quite certain that they were not nuclei, notwithstanding it was dog's blood we were examining, which is supposed to possess only non-nucleated blood-corpuscles. Although this peculiar effect of the water on the blood-corpuscles may have something to do, as we shall presently see, with secondary apnœa, we do not consider that it influences, to any marked degree, the rapid extinction of life in cases of complete submersion. The death in such cases is much too speedy to be thus accounted for. We shall shortly see that the difference in the time required to drown and to suffocate an animal must be due to an entirely different element, namely, the presence or absence of air in the lungs. That a moderate amount of air suffices to sustain life for some length of time is well illustrated, as regards the human being, in the case of sponge- and pearl- divers, who, through the influence of habit, are able to bear submersion for a period which would be exceedingly perilous to the non-habituated. Lefevre states that he has seen Navarino sponge-divers remain under water for nearly two minutes, their average time of submersion being about eighty seconds. Mr. Reynaldo, late Port-surgeon at Bombay, informs us that he has frequently timed the most expert divers in the Bombay harbour, and that some of them could sustain entire submersion for two and a half minutes. In order to accomplish this, however, they are forced to employ an artificial aid to the retention of the air in the chest. Immediately before diving, they forcibly distend the lungs with air, and instantly afterwards slip over the nose a clip made of bullock's horn, in order to prevent any involuntary expirations. The lips, being much more easily controlled than the nostrils, are left unprotected.

For the reasons given at pp. 885, 886, when treating in general terms of the effects of the introduction of water into the lungs, it cannot be said that the greater rapidity of death in submersion over simple apnœa depends on the deleterious action of the inspired water; and, as has just been shown, it is equally impossible to attribute it either to the struggling of the animal or to the external influence of the water on the frame. One is thus compelled to seek for another explanation of the phenomenon. It appears to our mind that the true explanation lies in the facts just alluded to, namely, that when the lungs are full of air, the escape of which is prevented, the animal obtains sufficient oxygen to support life for at least double the time it would do if they were entirely empty. Thus, for example, when the trachea of the animal is plugged, as in the experiments of the Committee, not only is the entrance of water prevented, but the exit of air is stopped. So also in the case of the pearl divers: the clip on the nostrils acts the part of the plug in the trachea, and, by putting a restraint on involuntary respiration, enables the individual to retain in the lungs a quantity of air from which the blood can extract sufficient oxygen to prolong life within certain limits.

Dr. Sanderson, moreover, informs us that he has been able to demonstrate this fact by direct experiment, and that he finds that in animals the duration of life, up to a certain point, is in an exact ratio to the quantity of air confined in the chest.

When an animal is entirely submerged and fills its lungs with water, all, or nearly all, the air contained in the pulmonary vesicles at the moment of its submersion is expelled, and it is thereby placed in the most unfavourable circumstances for the prolongation of its life. The same thing occurs when an animal is confined in a jar of pure nitrogen gas. The air in the lungs is rapidly replaced by a gas incapable of supporting life, and the animal speedily perishes—much sooner than if the lungs were filled with air and the trachea plugged. These facts, as we shall presently find, are of the utmost value in connection with the subject of treatment; for, as will be seen, paradoxical as it may appear, the best way to preserve life, under certain circumstances, is to stop breathing.

Effects of syncope in cases of drowning.—The occurrence of syncope is said greatly to augment the chances of recovery in cases of submersion. And it does so, no doubt, within certain limits, for the same reason as anæsthesia does, namely, by reducing the number of respirations. It has, however, a still further advantage in temporarily arresting tissue-metamorphosis, and thereby reducing the necessity for oxygen. We cannot, however, believe that syncope is capable of prolonging life beyond a very few minutes, for the simple reason that the heart's action cannot be arrested for even a very brief space of time without inducing a fatal result. In a drowned animal, although the movements of respiration stop much sooner, half as soon again as in a strangled one, the heart's action continues for nearly the same length of time, namely, from seven to nine minutes; and in neither case is it possible to resuscitate the animal after the entire cessation of the heart's action.

It appears to us that the majority of persons have most erroneous notions regarding the duration of syncope in general, and syncope under water in particular. Many cases, where the patient is not submerged, are mistaken for syncope, which are not in reality such; both the respiration and the heart's action continuing, but so feebly as, in a cursory examination, to escape detection. We doubt very much, judging from what we know of the phenomena of the cardiac action (for, be it remembered, there is no direct evidence one way or another), if it is probable, or even possible, for the heart to resume its action after five minutes' entire cessation. This leads to the question, *How long may a human being be under water, and yet recover?* This entirely depends on the degree of the submersion. If a person be completely submerged, and the entrance of water to, and exit of air from, the lungs not prevented, we believe that recovery would be impossible after two minutes. On the other hand, if the air-passages were closed against the entrance of water, and the chest kept full of air, we see no reason for thinking that a human being would perish either more slowly, or more quickly, than a dog placed under similar circumstances—namely, in from four to five minutes.

The reason why some persons remain a long time in the water, and yet ultimately recover, is that they are never, or at least only for a very short part of the time, totally deprived of air. Every now and then their heads come to the surface, and they obtain an inspiration. Even if they can but gasp in a small quantity of air, and that too accompanied with water, they may be able to struggle on for a long time, as it is only the total deprivation of air that kills quickly. A person can exist for an hour on a very small quantity of air, if it be but frequently enough exchanged. This fact we see illustrated every day in the persons of patients suffering from pneumonia supervening on phthisis, who struggle on for hours with only a portion of their lungs capable of performing the functions of respiration. Then, again, as regards the damage done to the pulmonary tissue by the entrance of water, that, we have already seen, can at most be but very trifling, for the liquid is rapidly absorbed into the circulation from the pulmonary vesicle, and leaves scarcely a trace of its transit (see p. 885).

The effect of water upon the blood itself is much more marked; for, as was said at pp. 890, 891, it thins the vital fluid, and when in large quantity even destroys a number of the blood-corpuscles. When we consider, however, the very large amount of blood in an adult body, at least fifteen pounds, and the proportionally small amount of water taken in at a time, we can readily understand how it is that its effects are rendered apparent only in cases of complete submersion. In the case of dogs whose lungs have been irrigated with water, it is difficult to detect any deleterious action of the water upon the blood-corpuscles; and this probably arises from its rapid elimination preventing any visible injurious dilution of the vital fluid. Such an action it must, however, to some degree exert.

The effect of temperature on the rapidity of death in cases of drowning.—The temperature of the water influences to some extent the rapidity of the fatal result. If we take the normal temperature of the animal as the starting point, we find that death is more rapid as we descend towards the freezing, and ascend towards the boiling point. The temperature of the human body being, in round numbers, 100° F.,—if a person be submerged in water at the freezing point, *ceteris paribus*, the quicker is the death. This conclusion we have arrived at from the results of experiments on animals, as well as from what we witnessed in the human being a few years ago, when fourteen persons were nearly drowned by the sudden breaking-up of the ice on the water in the Regent's Park. The explanation appears simple enough, when we remember that intense cold paralyses the muscular energies of the individual, and thereby prevents his continuing the efforts requisite to enable him to get occasional inspirations; consequently the person becomes totally submerged more quickly than he would otherwise be.

Heated water, on the other hand, seems to favour death by hastening the action of the already weakened heart, as well as by accelerating tissue-metamorphosis, and thereby increasing the demand for oxygen.

It is only when water is considerably below or above 100° F. that the effects of temperature become visible; a degree or two one way or the other gives rise to no apparent effect.

Apnœa the result of an absence of oxygen in the respired medium.—The simplest form of death arising from apnœa, or the non-arterialisation of the blood, is when there is no obstruction to the entrance of air into the lungs, but merely an absence of oxygen in the inspired gas. This is well illustrated, for example, when an animal is placed in a jar of nitrogen. It dies, and that too in a very few minutes; not from the introduction of a poisonous material into the system, but solely on account of the absence of oxygen in the inspired medium.

Nitrogen is perfectly harmless to animal life. We are constantly breathing it, and suffer no disagreeable effects from it. On the contrary, it is a necessary diluent of the oxygen of the air. The atmosphere normally contains no less than 79 per cent. of it. Nitrogen itself is, however, neither a supporter of combustion nor of life; hence it is that animals cannot live in it. Moreover, they die quicker in perfectly pure nitrogen than when strangled, for the reason previously given—namely, that the inhaled nitrogen displaces a certain amount of the oxygen from the air-vesicles, and thereby reduces the animal to the condition of one whose air-vesicles have been emptied of oxygen by water. The influence of nitrogen extends even somewhat farther. For, according to Graham's law of the diffusion, and Henry and Dalton's law of the absorption, of gases, the inspired nitrogen not only displaces the free oxygen present in the pulmonary air-vesicles, but withdraws the absorbed oxygen from the blood itself. This is probably the true explanation of the fact that animals die more rapidly when placed in perfectly pure nitrogen gas than when suffocated in any other way. Hydrogen acts in a nearly similar manner; but its effects on the animal body have not been sufficiently studied to admit of our drawing any general conclusions from them. Some have even hinted that hydrogen gas has special toxic properties; and if so, it ought, properly speaking, to come under the next head.

Apnœa from the inhalation of toxic gases and vapours.—There are very few gases that cause death by true apnœa. Most, indeed all, with the exception of nitrogen and hydrogen, and possibly even the latter, as has just been said, kill by means of their toxic properties. Although, therefore, we have been, compelled on this occasion to sacrifice scientific accuracy to common custom, and include under the headings of death by apnœa that arising from the introduction into the system of noxious gases and vapours from volatile liquids, we shall merely point out how their action is totally distinct from that of pure apnœa, and then pass on to another department of our subject.

In the case of the inhalation of each of the gases included under this head (see table at p. 887), carbonic acid, carbonic oxide, charcoal vapour, coal-gas, sulphuretted hydrogen, arsenuretted hydrogen, chlorine, sulphuric ether, chloroform vapour, &c., there may be, no doubt, an absence of oxygen in the respired medium; but in no one of these cases can this be regarded as the sole cause of the fatal result. Quite the contrary; it appears rather that the destruction of animal life in the majority, if not in all of these cases, depends much more upon the entrance of the toxic agent into the circulation, than upon the mere deprivation of oxygen. Consequently the symptoms manifested in cases of poisoning by these gases differ according to their chemical nature, and the intensity of their poisonous properties. Let us take arsenuretted hydrogen, for instance; if this gas be so given as to exclude the simultaneous introduction of oxygen, the animal dies not only much quicker than it does when its windpipe is tied, but also quicker than when it is suffocated in pure nitrogen gas; the cause of the difference in the rapidity of action being simply due to the toxic effects of the gas upon the nervous system. With chloroform the fact is equally well exemplified. Death from chloroform is commonly placed among the deaths from suffocation. Now, the results of the experiments of the chloroform Committee of the Royal Medical and Chirurgical Society (1864) have shown that a chloroform death is not one by apnœa at all, but is unmistakably one by pure asthenia. When the undiluted vapour of chloroform is introduced into the lungs, animal life is rapidly destroyed, much more rapidly indeed than under even the very quickest form of death by apnœa. Thus, while a drowned dog makes attempts at respiration during at least two minutes, and its heart's action continues to be perceptible for seven minutes, a dog poisoned with undiluted chloroform vapour inevitably dies in fifteen seconds; both respiration and cardiac pulsation being totally annihilated in that brief space of time. These are fortunately not the usual effects of chloroform; for since it is generally given in a diluted state, the oxygen of the atmospheric air with which it is accompanied suffices to arterialise the blood sufficiently for the maintenance of organic life. But even death arising from diluted chloroform vapour is in no case due to apnœa, but to the poisonous nature of the substance itself. This is proved by the cessation of the heart's action occurring almost as soon as efforts at respiration cease, as well as by the blood on the right side of the heart being darker than that on the left, neither of which is ever the case in apnœa; the heart in apnœa always continuing to beat two or three minutes after the respiration has stopped, and the colour of the blood on both sides being invariably identical.

Even carbonic acid circulating in the capillaries acts as a direct poison on the tissues. This we have seen well illustrated while studying the duration of the cardiac pulsations after different modes of death. Thus, the heart of a cat that has been suddenly deprived of life by section of the spinal cord at the vital point, will continue to pulsate, under favourable circumstances, for forty minutes after the animal's death: whereas the heart of a cat allowed to die slowly by strangulation, under the same circumstances, generally stops in less than twenty minutes after the death of the animal.

Enough, we think, has been said to show that these gases and vapours are in reality active poisons; and perhaps also sufficient to convince our readers that, notwithstanding the extreme interest of the subject, it would be injudicious for us to give to it more prominence in an essay on apnœa.

Theory of the Cause of Death in Apnœa.

Various authors in explaining, or attempting to explain, the reason of the cessation of the vital functions in cases of death by apnœa, have given very different views on the subject. One ascribes the death to a mechanical stagnation of the blood in the lungs (Haller's original doctrine). Another thinks it due to the non-stimulating venous blood failing to excite the heart's action (Goodwyn). A third, to the poisonous effects of venous blood upon the tissues (Bichat). A fourth, to the gradual failing of the blood to penetrate the pulmonary tissue (Alison). While, lastly, the doctrine which has now received almost universal assent is that first propounded by Kay, namely, that the cause of death in apnœa is due to the circumstance of the capillaries of the lungs, which usually convey arterial, being incapable of conveying venous blood; and consequently that the blood, as Haller said, stagnates in the lungs. Moreover, that the functions of the muscular organs, the heart included, gradually cease on account of this arrest of the pulmonary circulation, and not, as Bichat imagined, because of venous blood possessing any noxious quality.

It is thus seen that, in Kay's doctrine, although it is doubtless admitted that in death by apnœa the heart's action is weakened in consequence of the imperfect stimulus afforded to it by the venous blood penetrating its substance, the main cause of the failure of the circulation is supposed to be the difficulty which the non-arterialised blood finds in passing through the capillaries of the lungs.* This theory was thought consistent with all the phenomena observed in cases of death from apnœa. It will be found, however, from what has preceded, that in the explanation of apnœa, as now understood, this theory is open to certain grave objections. Indeed, the same observation is applicable to all the theories that have as yet been advanced; for the particular reason, that they one and all, with the exception of Goodwyn's, have for their foundation that part of the original doctrine of Haller which attributes the failure of the heart's power and loss of nerve-function to the arrest of the pulmonary capillary circulation.

The results of Goodwyn's experiments, had they been properly considered, might have led to a different conclusion from the above; for in them it is clearly shown that, for a time at least, the non-arterialised blood passes through the lungs, and enters the left auricle and ventricle of the heart. Moreover, in apnœa it is the right side of the organ that first ceases to pulsate. Bichat appears to have had a clearer idea of the sequence of death in apnœa than any previous or subsequent writer, and may be said to have only failed in arriving at the truth from having held to the idea that venous blood poisons the tissues with which it is brought in contact.

In attempting to explain the cause of death by apnœa, it is necessary to go a step or two farther than has hitherto been done; and, instead of merely limiting the question to an explanation of the most prominent of the effects of this mode of death, to attempt to follow up the subject until we arrive at the proemial cause of the arrest of the various functions. In order to do this, it is necessary to begin ab initio.

As is well known, the continual afflux of arterialised blood to the various animal tissues is a condition not only important but imperative to the continuance of life. All the molecular transformations of organised matter, of which 'life' is but the manifestation, are so utterly dependent on the continued supply of scarlet blood, that no sooner is it cut off than they instantly cease. Without oxygen there can be no life. Not a single new cell can be formed, not a single old one can be destroyed, without the influence of this all-important agent. From the first moment the animal germ springs into existence, during its development into tissues, and throughout its whole life as an organised body, up to the time of its death, arterialised blood is being uninterruptedly employed; and in exact proportion to its supply, ceteris paribus, are the many and intricate organic functions accelerated or retarded. Nervous action, muscular contraction, secretion, and excretion, are all equally under its sway; so that it is impossible to feel in the least degree astonished that in apnœa, which essentially consists in the arrest of the oxygenisation of the blood, all the functions of life should be rapidly brought to a standstill.

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* Vide Watson's *Lectures on the Practice of Medicine*, 3rd ed. vol. i. p. 69.

Apnœa may with perfect justice be defined as death from arrested interstitial nutrition.

Were it considered necessary to prove the basis on which this doctrine rests, there would be no difficulty in so doing; for all that is required is simply to draw a parallel between the effects of a deficient supply and an impaired quality of nutritive material on the various functions of the body, when it will be immediately seen that their effects are in reality identical. For example, we have a striking illustration of the effects produced on the body by a sudden deficiency in the supply of blood presented to us in cases of death by hæmorrhage. In these cases there is of course an actual absence of the nutritive materials; and, as will presently appear, that absence gives rise to precisely the same chain of symptoms as is met with in pure apnœa; which, on the other hand, is an apt illustration of the effects of an impaired quality of the material.

Thus, in death by hæmorrhage, there are the confusion of ideas, the unconsciousness, the convulsions, the stupor, the paralysis of the muscles, the stoppage of respiration, and, lastly, the cessation of the heart's action; all following upon each other in precisely the same order of sequence, and with the same ultimate result, as in those cases where there is no absence of the materials themselves, but only of that substance which fits them for the performance of their peculiar office—oxygen.

The same thing even occurs, when not only the materials but also the oxygen itself is present, if the two are prevented from combining, and thereby becoming fitted for the purposes of nutrition. This occurs, for example, when there is present in the circulation a foreign material which possesses the property of preventing the constituents of the blood from entering into combination with oxygen. In such a case, precisely the same symptoms may be induced as we have seen follow either the entire absence of both nutritive materials and of oxygen, as in hæmorrhage; or only an absence of oxygen, as in apnœa. Alcohol might be cited as an example of a substance possessing the power above alluded to; and the symptoms it gives rise to, when taken in a poisonous dose, closely resemble in many respects the effects of slowly-induced apnœa. The peculiar effect which alcohol exerts in preventing the oxidation of the constituents of the blood has been illustrated by us in the following manner:

A certain amount of cow's blood was confined with an equal quantity of pure atmospheric air, and kept at a moderate temperature during twenty-four hours. At the expiration of that period the air was found to have undergone a change: it had lost oxygen and gained carbonic acid.

For, while the pure atmospheric air brought in contact with the blood consisted of

Oxygen	20·960	total 20·962
Carbonic acid . . .	0·002	
Nitrogen	79·038	
	100·000	

that removed from the retort after its twenty-four hours' contact with the blood consisted of

Oxygen	10·58	total 14·91
Carbonic acid	3·33	
Nitrogen	86·09	
	100·00	

thereby showing that oxygen had been absorbed, and carbonic acid exhaled. To a precisely similar quantity of blood from the same animal was added 5 per cent of alcohol. The blood was then placed in contact with an equal amount of pure atmospheric air, and kept twenty-four hours at the same temperature and under precisely the same circumstances as the others; notwithstanding which the air on analysis was not found to have become nearly so much changed as in the second case when it was in contact with pure blood. On the contrary, the air was found on analysis to consist of

Oxygen	16·59	total 18·97
Carbonic acid	2·38	
Nitrogen	81·03	
	100·00	

proving that alcohol possesses to some extent the power of arresting the arterialisation of the blood, and thereby its becoming fitted for the purposes of nutrition.*

The effects of alcohol and many other substances on the nervous system are, in a great measure, due to their action on the blood; and if the above explanation be the correct one, there can be no difficulty in understanding why, in certain cases of poisoning, the symptoms so frequently resemble in some respects those met with in pure apnœa.

As a further illustration of the intimate connection between functional activity and oxidation, we might call attention to what is observed to occur during muscular contraction.

It is a well-known fact that the exposed muscles of the frog absorb oxygen and exhale carbonic acid in definite proportion, so long as muscular irritability continues; and that as soon as the irritability of the muscles ceases, an important difference occurs in the amount of the gases interchanged. Moreover, we have found that anything that interrupts the interchange of the gases tends to arrest the muscular action. This is best seen in connection with the rhythmical action of the involuntary muscles of the heart when it has been separated as far as possible from all nerve-influence. As is well known, the extirpated heart of a healthy frog will continue to pulsate regularly for an hour after its separation from the nerve-centres; we have, however, observed that if the heart be placed in contact with any of those substances that possess the power of preventing the arterialisation of the blood, its action is speedily arrested. In illustration of this we may cite the following experiment which we performed several years ago (*Lancet*, 14th June 1856).

When the hearts of two frogs are removed from the body, and one placed in pure distilled water, while the other is put into a solution of the acetate of strychnia (strychnia has the power alluded to, of preventing the absorption of oxygen and exhalation of carbonic acid by the blood), the former will pulsate regularly for more than an hour, the latter will cease to beat in from *one* to *five minutes*, according to the strength of the solution of the poison. And what is still more remarkable, the contractile power of the heart is gone for ever. Mechanical, chemical, or galvanic stimuli alike fail to reawaken it.

[Since the foregoing was written, we have had occasion, in the capacity of member of the Royal Medical and Chirurgical Society's Chloroform Committee, to study the effects of the direct action of the vapour of chloroform and ether upon the heart. For this purpose the following experiment was performed:—Three small glass jars were placed in a row, and each covered with tin-foil from the centre of which descended a small hook, to which was attached by the aorta the heart of a healthy frog. All three were retained under precisely the same circumstances, with the exception that in the bottom of one jar were a few drops of chloroform, in another a similar quantity of ether, and in the third the same amount of distilled water. The result was, that while the heart that was suspended in aqueous vapour pulsated regularly for an hour or so, that in ether-vapour stopped in less than fifteen minutes, while the one in the atmosphere of chloroform ceased to pulsate within ten minutes. Facts which add still further strength to the foregoing opinion.]

No one, we suppose, at present doubts the fact that the ultimate cause of death in apnœa, no matter in what manner it may be induced, is the absence of oxygen. We may add, that in our opinion this absence of oxygen acts indirectly, and that the extinction of animal life is in consequence of the constituents of the blood not having undergone the oxidation-process, which is essential to the proper performance of their functions when brought in contact with the various tissues and organs of the frame. The confusion of ideas, the unconsciousness, the convulsions, the stupor, the paralysis of the muscles, the stoppage of respiration, the arrest of the heart's action, appear to us to be one and all due to the same cause, *arrested interstitial nutrition.* It is thus seen, then, that what others have hitherto regarded as the primary cause of death in apnœa, namely, the stoppage of the circulation in the lungs, the failure of the heart's action, &c., we look upon as merely the secondary effects of the gradual extinction of life. No one would, of course, venture to assert that the above is of necessity the true explanation of death by apnœa; for all are well aware that, as science advances, new facts may be discovered which may either demand its modification or abandonment; but one thing we may venture to assert, namely, that this 'arrested interstitial nutrition' theory is by far the least open to objection of any that has hitherto been propounded, and that it has the advantage not only of giving a rational explanation of the symptoms, and their order of sequence, but is also in perfect conformity with the appearances observed after death.

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* See the author 'On the Influence of Physical and Chemical Agents upon Blood with special reference to the Mutual Action of the Blood and the Respiratory Gases, *Phil. Trans.* 1865, p. 717.

SECONDARY APNŒA.

We have now to call attention to the fact which has been so frequently observed, more particularly in cases of drowning, that an individual may apparently recover from the primary effects of apnœa, and after the lapse of some minutes, hours, or days, suddenly expire without any apparent cause. This secondary death occurs not only after drowning, but after each and all of the causes of apnœa given in our table. Indeed, it is not much less common after hanging than after drowning; and it has been equally observed after the administration of poisons, more especially of the volatile group denominated anæsthetics.

Lest some may imagine that the secondary form of death now under consideration is nothing more than death following upon imperfect resuscitation, we may at once inform them that it is entirely different. Take, for example, a case of drowning; and we may quote the following, which we heard of in consequence of the gentleman in whose practice it unfortunately occurred being unjustly accused of having treated the case improperly The patient, a healthy young man, while bathing, accidentally got out of his depth, and before being rescued became much exhausted. On his removal from the water, he was quite unconscious, although the respiratory process still continued. The usual restoratives were applied, and the patient was soon able to speak. He was taken home, and, at the suggestion of the medical attendant, who considered him out of all danger, had some opening-medicine given to him and was put to bed. In the middle of the night, about ten hours after his immersion, he was suddenly heard, by a person who occupied the same apartment, to make a noise, as if in a convulsion. When a light was obtained, it was found that he had become quite livid in the face; and before medical aid could be procured, he expired. At the post-mortem examination nothing was detected to account for the sudden death.

This we regard as a death from secondary apnœa.

Sir B. Brodie relates the case of a lad who was found hanging by the neck insensible, who died twenty-four hours after he was cut down; and at the post-mortem examination nothing abnormal was detected in the body except congestion of the cerebral vessels.

Linhart, again, relates a most interesting case of a perfectly healthy peasant who died eighteen and a half hours after having been rendered only partially insensible by an ounce and a half of chloroform given in the usual way over a period of thirty minutes. The patient continued perfectly well until the next morning at six o'clock, when he suddenly died. On examining the body, twenty-four hours after death, all the organs were found healthy.

These cases, which have generally been classed under the head of death either arising from collapse or of spasm of the glottis, are certainly peculiar; but nevertheless we consider them as merely the secondary results of the arrested interstitial nutrition that took place during the period that the breathing was partially arrested.

If we may be allowed to use a homely expression in order to illustrate how the secondary apnœa may arise from a preceding mal-nutrition, we should say that it does so in the same way as a single layer of bad bricks put into a house while building may cause at a subsequent period its premature decay; the layer of bad tissue laid down during the temporary cessation of respiration induces the subsequent premature decay of animal life. This theory will be still better understood if we illustrate it by what is observed to occur to horses after temporary starvation.

Many years ago the French government appointed a commission to enquire into the effects of starvation on cavalry horses; and the results obtained were not only interesting, but most important. Among others, for example, it was found—

1st. That after ten days' total deprivation of food, a horse is still able to gallop, although not very long; and after being again well fed, makes a tolerably rapid recovery.

2nd. That a horse may live for twenty days without nourishment of any kind, and still make a temporary recovery.

3rd. That an animal starved for a certain time, although he makes a temporary recovery, never regains his pristine strength, no matter how well fed he may subsequently be.

Thus it was found, that though the horses that had been kept fasting during a period of ten days, and then well fed, apparently recovered rapidly from the effects of the starvation, yet they never were so strong as other horses, and that they succumbed to disease much more readily than others. This failure in the vital stamina, if it may be so termed, we believe was owing to the mal-nutrition that occurred during the previous term of starvation. The subsequent death of the horse might therefore be said to be the secondary result of starvation. The peculiar condition of the red blood-corpuscles, which was mentioned as occurring in case of drowning, may in some degree aid in the understanding of what is here termed mal-nutrition, as applied to the secondary apnœa of drowning. It will be remembered that, while abundance of serrated blood-corpuscles was found in the blood of the right side of the heart, there was not only a total absence of them in the watery blood of the left, but that a great number of the normal blood-cells had disappeared; the field being occupied by small granular bodies, looking something like nuclei, that might have escaped from the swollen and burst corpuscles. This observation was of course made upon a fatal, and consequently exaggerated, case; but it is very easy to imagine a less formidable one, in which, during the period of recovery from the effects of drowning, a layer of bad tissue might be deposited from the partially disorganised blood-corpuscles, which of necessity would diffuse themselves throughout the circulation along with those that had escaped the pernicious action of the water. We are here speaking of the visible effects of drowning upon the circulation; but how many and intricate are the changes which may have taken place in the blood, during the period of apnœa, that are entirely beyond the cognisance of our senses!

In order properly to comprehend the meaning and pathology of secondary apnœa, it is necessary to have a clear idea of the process of nutrition.

It is a common belief that, as we eat and sleep at stated periods, nutrition is not a constant but an intermittent function; an opinion from which we entirely dissent, as not being in conformity with the present state of physiological science. To our mind nutrition appears to be a constant process; fluctuating, it may be, but nevertheless continual. The secretion of milk, urine, bile, and semen goes on during every hour of the day and every minute of the night. It is only the expulsion of the accumulated products that is periodic. So again with food. Just as the camel can pass several days without drinking, if he has previously supplied his reservoir with water, so can man go several hours without eating, if he has previously laid into his stomach a stock of food. The animal, like every other machine, to do constant work must have a constant supply of material. Life, indeed, might not inappropriately be compared to a web of cloth made of the purest American cotton, and each stoppage in nutrition to a flaw. Thus each disease, each temporary illness, although not producing an actual gap, would weaken the web by introducing into it an inferior quality of cotton. It might only be a single thread, or it might be many threads; but still the web would be weakened by their presence. Do we not every day see around us evidence of the flaws in the human webs? Look, for example, at the teeth. Are the furrows we occasionally see across them not the tell-tales of the severe illness of youth? Are they other than the marks of arrested nutrition? So again with the nails: do they not, after a smart attack of scarlet-fever, indicate by their grooves the severity of the illness? Can the falling out of the hair after typhus be said to be due to anything else than temporarily arrested nutrition? Even the mind itself does not escape the general ill. Bad tissue deposited produces bad memory. Old people remember distinctly all that occurred to them in their youth, when good tissue was being laid down; but forget the occurrences of the previous day, when in old age the material is of an impaired quality. So also it is found, and for a similar reason probably, that it occasionally happens that, after a severe illness, little is remembered of what occurred during it. Interstitial nutrition is constantly going on, and it cannot be for an instant interrupted without threatening to bring the machine to a stand-still. Moreover, we might go a step farther, and say that the more quickly it does its work the sooner will its labours cease. Waste and repair cannot go on indefinitely in the animal body any more than in the locomotive. Supply the engine with coals and water as carefully as you will, it will still wear out. That is, however, not the point with which we have at present to deal. It is the temporary arrest of the supply of material we are now considering; and as we have already said, during the period of apnœa it is that supply that is interfered with, and makes the flaw which, although not sufficiently great to produce at once a rent in the web (immediate death), sooner or later causes it to give way (secondary apnœa).

TREATMENT OF APNŒA.

In considering the treatment of cases of impending death by apnœa, it will be advisable, in order to save time and space, first to lay down the general principles on which it is founded, and afterwards proceed to show in what manner these require to be modified in their application to special cases.

Having ascertained from the history and symptoms that the case is one of apnœa, and not of narcotic poisoning or apoplexy, which, as has been previously shown, under certain circumstances may be confounded with it, the first thing to attend to is the removal of all visible impediments to the natural performance of the respiratory process, and then as rapidly as possible to place the patient under the most favourable circumstances for the reception of a free supply of air. Having done so, time may be taken to enquire more minutely into the state of the patient, and thereby obtain some notion of the probable chances of recovery.

If the eyes are open, the pupils dilated, the conjunctiva insensible, the countenance placid, the skin cold, frothy mucus round the nostrils and mouth, no attempt at respiration, and the heart's action inaudible, the case is hopeless. N.B. As the pulse ceases to be perceptible at the wrist some before the action of the heart entirely stops, the ear must in all cases be applied to the chest before definitely concluding that the case is hopeless.

If, on the other hand, there is the slightest evidence of respiratory effort, of heart's action, of twitching of any of the muscles, and especially if the apnœa is known to have been of short duration, there is every hope of recovery; and in direct proportion as either or all of the above signs are marked, are the chances of recovery increased. As the primary object in all cases of apnœa is to arterialise the blood as rapidly as possible, various methods for the accomplishment of this object have at different times been proposed. Numerous forms of apparatus have also been invented, in order the more readily to perform artificial respiration, several of which we have tried (Erichsen's, Sibson's, Marcet's, &c.); but we cannot venture to recommend their employment. First, they are not always at hand; secondly, there is no time to send for them, even although they could be procurable in the short space of two minutes; thirdly, they are troublesome in the application; and fourthly, after a pretty large experience with them on animals, we may venture to affirm that they are at last not more effectual than the apparatus-less modes we are now about to describe.

1st. Artificial respiration by simultaneous pressure on the abdomen and thorax.

2nd. The Marshall-Hall method.

3rd. The Silvester method.

Artificial respiration by simple pressure on the abdomen and thorax.—As is familiar to everyone, a certain volume of air can be expelled from the thorax by forcible compression of its walls; on the removal of the pressure, the walls of the chest return to their former position in consequence of their own elasticity, and air rushes into the lungs in order to fill up the vacuum thereby produced. Consequently, by a regular repetition and relaxation of pressure, a species of artificial respiration may be induced, the volume of air inhaled and expelled varying with the amount of the pressure.

When manual pressure equal to about 30 lbs., which is not greater than may be with perfect safety applied to an adult human subject, is made over the lower part of the sternum and upper and middle portion of the abdomen, from 8 to 20 cubic inches of air are expelled, and readmitted on the relaxation of the pressure; and by repeating this twenty or thirty times in a minute, sufficient oxygen may be obtained to support life.

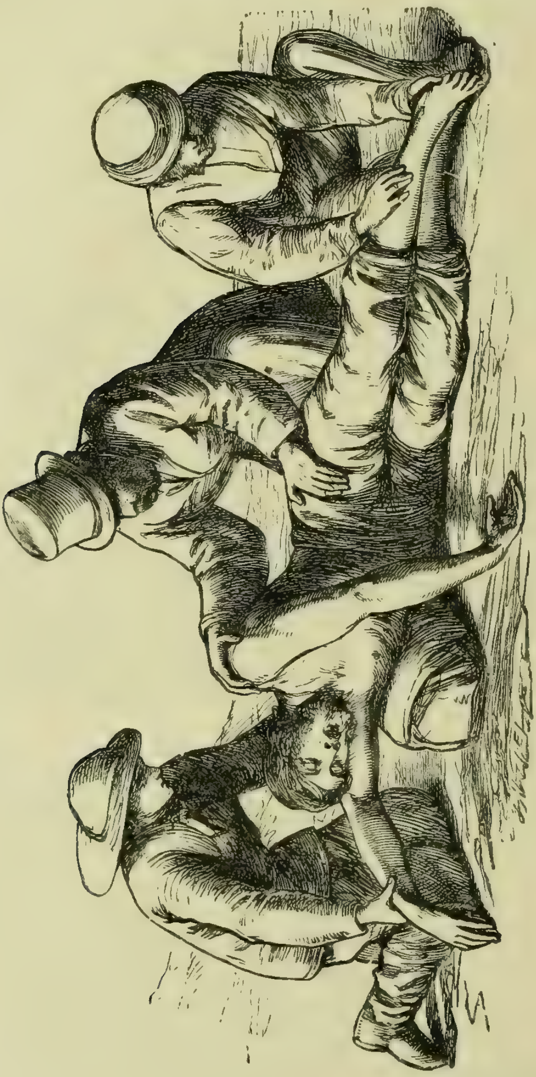
In making the abdominal pressure, care is to be taken to observe if any food is forced out of the stomach, which may happen if that viscus is full; and if so, it is necessary that care be taken to prevent it getting into the windpipe. This may be readily done by placing the patient for a few seconds on his face and forcibly expelling the food.

The pressure ought not to be made on the upper part of the sternum, for the resilience of the thoracic walls there is not great enough to allow of the expulsion of sufficient air for the purpose of respiration; nor is the pressure on the abdomen to be omitted, else the diaphragm will descend, and counteract the benefit derived from that made on the lower part of the chest.

Dr. Marshall Hall's method of performing artificial respiration.—The method of imitating natural respiration recommended by the late Dr. Marshall Hall is too well known for us to take up time in describing it; we may simply mention that it consists essentially in 'turning the body gently on the side and a little beyond, and then briskly on the face, alternately;' and in making pressure along the back of the chest each time the body is brought into the prone position. Within the last few years this method has been largely practised throughout the country, and most favourable reports of its efficacy have from time to time been published by different gentlemen in the weekly periodicals. Notwithstanding this, however, we must admit that we are extremely sceptical regarding its advantages; and we are doubtful if the recoveries which are reported as having taken place under its use have been attributed to the proper cause. But lest it should be thought that we have an improper bias for any particular method, we shall, in preference to giving our own views regarding the comparative value of the Silvester and Marshall-Hall methods, give the published opinions of the Royal Medical and Chirurgical Society's Committee, with which our own entirely accord. The committee applied the 'ready method' and the 'physiological method,' as they were termed by their respective proposers, to a number of recently dead human subjects, in exact accordance with the published instructions by the authors; and the conclusions they arrived at are the following: *

'As regards that part of the method which consists in turning the body

FIG. 423.



Inspiration.

alternately "very gently on the side and a little beyond, and then briskly on the face," it was found that the volume of air exchanged was variable in the same subject; but always inconsiderable. It usually happened that a quantity of air, varying from 1 to 8 cubic inches, never more, generally much less than 8, was

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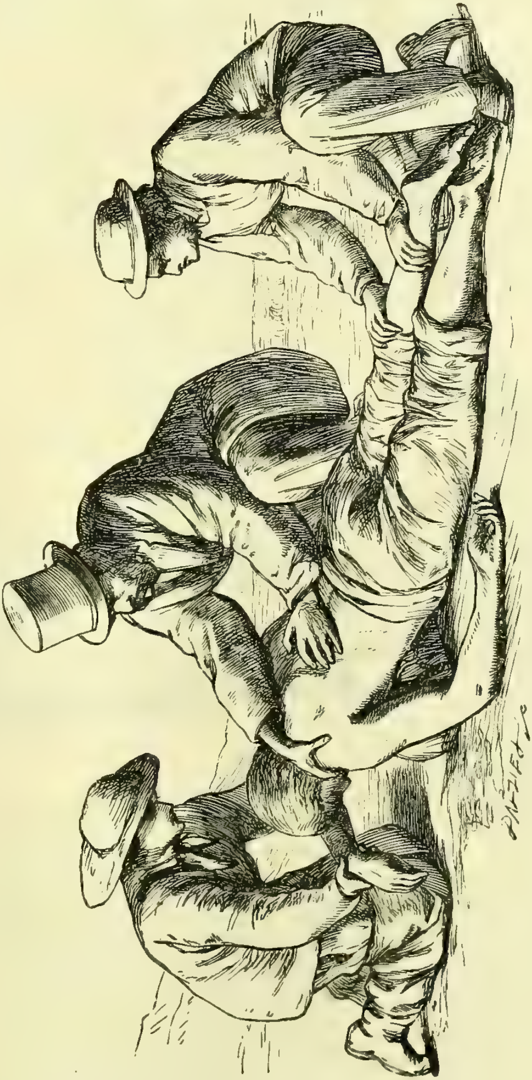
* *Med.-Chir. Trans.* vol. xlv. p. 488.

inspired when the body was turned from the supine posture to one side. When the body was placed on the abdomen with the head resting on the forearm, a somewhat larger quantity was expelled, never exceeding 10 cubic inches. On restoring the body to the lateral posture, the amount of air inspired was usually less than that which had been expelled by pronation. But the quantity expelled and inspired in each movement was scarcely ever precisely equal.

Fig. 424.



Expiration.

'The volume of air expelled when the body was placed on the face was much increased if pressure was at the same time made on the spine, the amount of this increase varying according to the degree of the pressure and in those experiments in which such pressure was made, it was found that the quantity of air which was inspired on rotation of the body to the side was much less than that which had been expelled by pressure.

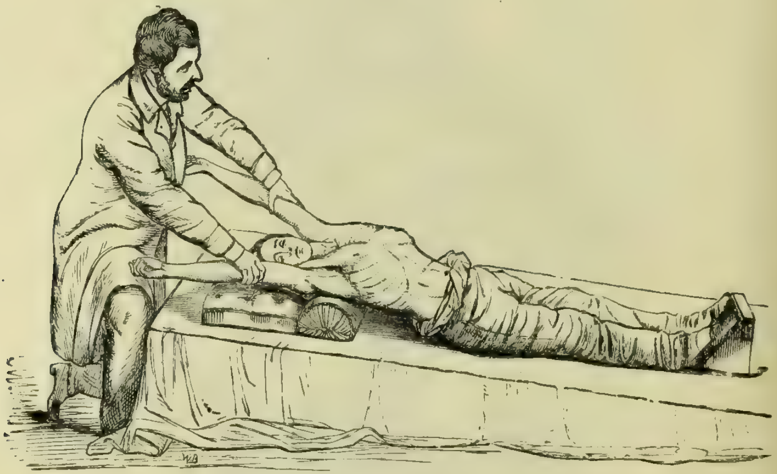
'As regards the whole amount of exchange of air produced by the method of Dr. Marshall Hall, " to imitate respiration," it varied much according as the subject was favourable or the contrary, sometimes not exceeding a few cubic inches, but never exceeding 15 cubic inches.'

Figs. 423, 424 illustrate, more fully than any number of words can, the positions of the body during the employment of Dr. Marshall Hall's method of inducing respiration.

Physiological method recommended by Dr. Henry R. Silvester.—Dr. Silvester's method consists in the imitation of the action during deep inspiration of the pectoral and other muscles passing from the shoulders to the parietes of the chest. The inspiratory effort is imitated by slowly extending the arms upwards by the sides of the head until the elbows nearly touch each other. The expiratory effort is performed by restoring the arms to the sides of the chest, and slightly pressing them against it.

In performing Dr. Silvester's method on the same subjects that were either previously or subsequently employed in practising the 'ready method,' the Committee 'found that, on extending the arms upwards, a volume of air was inspired into the chest which varied, in different subjects, from 9 to 44 cubic inches; and it was observed that the results obtained in successive experiments on the same body were remarkably uniform, in which respect, as well as in their quantity or amount, they contrasted with those obtained by the method of Dr. Marshall Hall. On restoring the arms to the side, as directed by Dr. Silvester, the quantity of air expelled was generally nearly equal to that previously inspired; occasionally less.

Fig. 425.

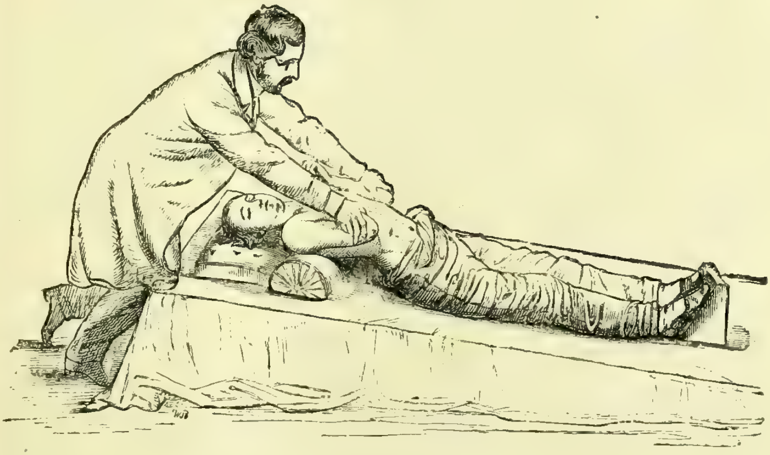


Inspiration.

'Dr. Silvester recommends that on bringing down the patient's arms they should be gently and firmly pressed against the sides of the chest, so as to diminish the cavity of the thorax. It was found that this pressure could be exercised with greater facility, and equal effect, by placing the hands on the lower third of the sternum, as already above described. By alternating the movements of the arms with pressure of this kind, a regular exchange of air was produced, the quantity of which, in several instances, exceeded 30 cubic inches, and in one instance amounted to 50 cubic inches. In those cases in which a less respiratory effect was produced, the deficiency was always distinctly attributable to unfavourable conditions, particularly the existence of obstructions in the respiratory passages.

'Without expressing an opinion as to the efficacy of the method of Dr. Silvester as a means of restoring suspended animation in cases of drowning, its claims to be considered as an effectual means of producing an exchange of air similar to that effected by the respiratory movements appear to us to be satisfactorily established. As has already been pointed out by Dr. Silvester, the condition of the thorax after the cessation of breathing being that of expiration, it is desirable that the first step in the restoration of breathing should be a movement of expansion; in this respect the method he has proposed enjoys a marked superiority over that of Dr. Marshall Hall, which has for its object to force air from a chest which has already discharged its natural quantity. It also appears to be an important advantage in this method, that, in each movement of expansion, both sides of the chest are left free from compression, and therefore free to move, while the postural method of Dr. Marshall Hall leaves only one side free to expand. As regards facility and readiness of application, there is also no doubt that the method recommended by Dr. Silvester is at least equally if not more effective than the Marshall-Hall plan.'

Fig. 426.



Expiration.

The Committee further made the following important observations on

Artificial inflation of the lungs through the mouth.—'A few experiments were performed relating to the efficiency of the inflation of the lungs through the mouth of the subject, which led to the conclusion that with proper precautions such inflation is perfectly practicable. The following were among the results noticed:

'1. As regards the position of the tongue and its influence in impeding the entrance of air, it was found that in the dead body this organ is apt to offer great obstruction to inspiration by falling back into the pharynx and closing the laryngeal aperture. No air could be forced through the mouth in a body lying on the back so long as the tongue remained undisturbed: but when it was drawn forward and held out of the mouth by a ligature, or by the pressure of the teeth upon it, air could be injected by the œsophagus and larynx, so as to distend both the abdominal and thoracic cavities. On leaving the tongue loose in the mouth, and allowing it to fall back by its own weight, air could also be introduced; but much less freely than when it was drawn forwards. Complete obstruction to the passage of air was produced by pressing the tongue back into the pharynx, no air entering either the larynx or œsophagus.

'When the head of the subject was allowed to hang back over the edge of the table, air seemed to pass into the chest more readily than when the back of the head rested upon the table.

'2. It was found that the whole quantity of air introduced by inflation could be compelled to enter the respiratory cavity by pressing back the larynx against the spinal column. By this expedient the passage of air down the œsophagus was at once intercepted; while its transit down the trachea continued to take place as freely as before, so that it affords a ready means of preventing the passage of air into the stomach during artificial respiration.

'3. During inflation of the lungs, a sound closely resembling that of the ordinary vesicular murmur is plainly heard, proving that air enters not merely the larger air-passages, but the vesicular structure of the lungs. Marked expiratory murmur was also heard during the recoil of the lungs and thoracic parietes after inflation. In cases where the bronchial tubes were obstructed by secretion, the various kinds of crepitation could be distinguished.

'*Rigor mortis.*—The effects of rigor mortis were judged of by observations on one subject especially. It was observed that, after prolonged experiments, the rigidity, which at first existed in a marked degree, was completely overcome and abolished by the repeated movements of the arms and thoracic parietes. As this change took place, the quantity of air inspired and expelled increased, so that at the end of the period of observation the results were nearly twice as large as they were at the beginning.'

The Committee summed up its labours by making the following suggestions regarding the treatment of apnœa generally; but in giving to them all due consideration, it must be borne in mind that the investigations of the Committee related only to two forms of apnœa—that produced by a simple mechanical obstruction to the entrance of air into the lungs, and that produced by drowning. Its conclusions are as follows:

'That all obstruction to the passage of air to and from the lungs be at once, so far as practicable, removed; that the mouth and nostrils, for example, be cleansed from all foreign matter or adhering mucus.

'That, in the absence of natural respiration, artificial respiration, by Dr. Silvester's plan, be forthwith employed in the following manner: the body being laid on its back (either on a flat surface, or better, on a plane inclined a little from the feet upwards), a firm cushion, or some similar support, should be placed under the shoulders, the head being kept on a line with the trunk. The tongue should be drawn forward, so as to project a little from the side of the mouth; then the arms should be drawn upwards until they nearly meet above the head, the operator grasping them just above the elbows, and then at once lowered, and replaced at the side. This should be immediately followed by moderate pressure with both hands upon the lower part of the sternum. This process is to be repeated about twelve or fourteen times in the minute.

'That if no natural respiratory efforts supervene, a dash of hot water (120° Fahrenheit) or cold water be employed, for the purpose of exciting respiratory efforts.

'That the temperature of the body be maintained by friction, warm blankets, the warm bath, &c.

'In the case of drowning, in addition to the foregoing suggestions, the following plan may be, in the first instance, practised: place the body with the face downwards, and hanging a little over the edge of a table, shutter, or board, raised to an angle of about 30°, so that the head may be lower than the feet. Open the mouth and draw the tongue forward; keep the body in this position for a few seconds, or a little longer if fluid continues to escape. The escape of fluid may be assisted by pressing once or twice upon the back.'

There are two other methods still to be alluded to: one by Professor Pacini,* the other by Dr. Bain. In the former the asphyxiated patient is placed horizontally on a bed or table; the operator, standing with the head against his own belly, takes hold of the patient's shoulders, by applying the thumbs in front of the heads of the humeri, and the four fingers behind and close to the arm-pits. He then pulls the shoulders towards him, and lifts them in a perpendicular direction, by which means the thoracic cavity becomes enlarged, both in its transverse and antero-posterior diameter, thereby admitting the ingress of air, which is expelled on the shoulders being replaced in the former position. If the patient is on the ground, the operation is performed by the practitioner while kneeling.

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* *Di un nuovo Metodo di praticar la Respirazione artificiale.*

Dr. Bain thus describes his method: 'The patient being laid on his back on a table, if convenient, the mouth and nostrils are to be wiped dry—the clothes from the upper part of the body, at least, having been removed. The operator stands at the head of the patient, placing the fingers of each hand in the axillæ, in their front aspect, with the thumbs on the clavicles, and pulls the shoulders horizontally towards him with a certain degree of power. Upon relaxing his pull the shoulders and chest return to their original state.'

These two methods are therefore but a mere modification of Silvester's plan, the modification consisting in the upper, instead of the lower, part of the arms of the patient being the point of traction.

A Committee appointed by the Roy. Med. and Chir. Soc. examined these respective methods, and found that although more air can be made to enter the chest when the traction is made upon the shoulders instead of the fore-arm or arms, the difference is so slight that in the great majority of cases it is of comparatively little moment which method of manipulation is practised, provided the common principle on which they are founded is fairly carried out.*

Having said thus much on the general bearings of treatment in cases of apnœa, we have now to consider some of the special bearings as applicable to particular cases. It will be remembered that we classified the different forms of apnœa under the four heads of—that arising from a mechanical impediment to the entrance of air into the lungs, that produced by drowning, that caused by an absence of oxygen in the inspired medium, and that due to the inhalation of a toxic gas or vapour. As regards the first of these causes; it ought never to be forgotten that apnœa may arise from mechanical causes, and yet, *even while the cause exists*, it may fail to be detected, and the patient be allowed to die in consequence. This happened not long ago. A cabman, sitting on the step of his cab, eating his dinner, was suddenly hailed by a fare. He jumped up, pushed the remainder of his meal into his pocket, sprang on to the box and seized the reins, when immediately afterwards he was observed to become livid in the face, and with scarcely a struggle fell back insensible on his seat. A hospital being close at hand, he was instantly conveyed thither; but although only a few minutes had elapsed, he was found to be dead almost as soon as he was brought into the waiting-room. The case was thought to be one of apoplexy, and was treated as such; that is to say, nothing was done: no attempt at resuscitation was made; and it was not until the autopsy revealed the true cause of death that the idea occurred that the man's life might have been saved. A piece of unchewed meat was found sticking in the throat and plugging up the opening into the larynx. There can be but little doubt that if this had been discovered and removed when the man was first brought into the hospital, its removal, in all probability, would have been followed by recovery, either with or without artificial means. Cases of this kind are not so very uncommon. Several have been reported in the journals.† It ought also to be borne in mind that suicide and even murder have been committed by thrusting substances into the fauces. A pocket-handkerchief is said to have been the instrument in one case; a ball of cotton in another.

It also occasionally happens that children are suffocated in attempting to swallow their playthings. In 1851 we saw Trousseau rescue a child from impending death by the timely performance of tracheotomy, and the extraction of a cherry-stone which had become lodged in the trachea. It is not necessary even that the plaything enters the trachea; if it be of considerable size, as in the case of a whistle, it may stick in the œsophagus, and by its pressure on the trachea obstruct the entrance of air into the lungs.

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* *Trans. Roy. Med.-Chir. Soc.* vol. liii.

† In University College Museum is a preparation which illustrates admirably how firmly the larynx may get plugged with a fragment of unchewed meat.

Feeble children, and still more frequently intoxicated adults, have been suffocated from food ejected out of the stomach getting into or blocking up the orifice of the trachea. A drunken man perished once after vomiting, from a piece of potato-peel covering the glottic orifice. The cause of death remained unknown until it was revealed at the post-mortem examination.*

On more than one occasion it has happened that not only during life, as in the above cases, but even after the autopsy, and until a second and more searching examination of the body has been made, the true cause of the apnœa has failed to be detected.

It may be useful, perhaps, to know that in nearly all cases of plugging of the respiratory passages, a clue may be obtained to the mischief by the lungs refusing to collapse on the chest being opened. This of course arises from the air contained in them being unable to find an exit in the usual way.

As regards the accidental suffocation of children by bedclothes, or wearing-apparel too closely covering their faces, we would remark that this accident, which has occasionally arisen from excessive care as well as excessive carelessness, the practitioner is in some cases able to remedy. Cases of this kind, when seen sufficiently early, are admirably adapted for treatment by artificial respiration. There being no violence or injury of any kind either to the air-passages or to the lungs, death arises from non-arterialisation of the blood in one of its least complicated forms. So that, if the heart's action is still perceptible, no matter how feeble it may be, the chances of recovery by artificial inflation are exceedingly great. We have just said that this accident may happen from excessive care; a good example of this occurred not long ago. A young mother, while carrying her first-born to church to be baptised, in order the more effectually to protect it from the cold, turned up the end of her shawl, and drew it over the infant's head. On arriving in church and uncovering her charge, she for the first time discovered that her excessive care had proved fatal to her child.

In a case of this kind inflation should be had recourse to, even after the heart's action has stopped; and it should be continued for at least a quarter of an hour or twenty minutes. We have seen new-born children recover after that period from suffocation.

Artificial respiration in infants is to be done differently from any of the modes we have hitherto described. The muscles of the new-born are not sufficiently developed to make the Silvester method effectual; and as for the Marshall-Hall and the manual-pressure methods, in cases of still-birth they are simply impossibilities; for, as the child has never breathed, there is no air in the lungs to expel, either by one or the other method. Even if the child has breathed, the thoracic walls are scarcely sufficiently strong and elastic to enable these methods to be adopted with much prospect of success. In children, at least under six months old, mouth-to-mouth inflation is by far the simplest and most effective mode of artificial respiration.

The operation is best performed by placing the child on a pillow on the table, with its head to the operator's left hand. The operator placing himself on a chair, after wiping the mouth and nostrils clean, should seize the larynx between the thumb and forefinger of the right hand, and press it gently but firmly upwards and backwards. This is done with the object of facilitating the entrance of air into the lungs, and at the same time preventing any passing down the œsophagus into the stomach. The nostrils are then closed with the left hand, and the operator proceeds to distend the child's lungs with air by placing his lips over its mouth and blowing steadily into it. Having done so, he removes the hand from the larynx and gently aids in the re-expulsion of the air from the lungs by pressure on the lower part of the sternum. This is to be repeated twenty or twenty-five times in the minute. We have frequently adopted this method, even on premature children, with perfect success. As an example of this mode of procedure, the following case, which to us is one of more than usual interest, may be related:

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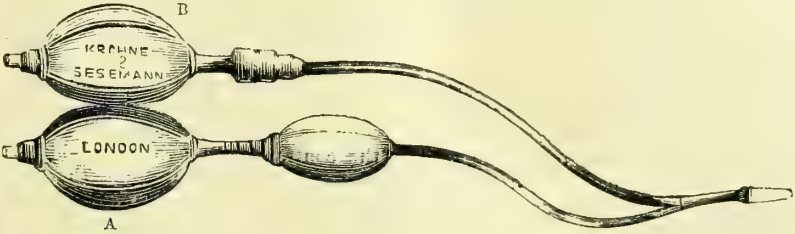
* *Edin. Med. and Surg. Journ.* 1844.

In 1850, while house-surgeon to the Royal Maternity Hospital in Edinburgh, we extracted a child by the Cæsarean section after the death of the mother.* It was only a seven-and-a-half months' child, and on extraction neither pulsation in the cord, nor the slightest movement of the heart, was perceptible. Mouth-to-mouth inflation was immediately had recourse to, in the manner above described; and after at least ten minutes' labour it succeeded in restoring the heart's action, which was soon afterwards followed by respiratory movements, which, though feeble for a time, soon became sufficiently strong for the purposes of life. After the lapse of nineteen years the individual was ascertained to be still alive, and a fine healthy young man.

It is sometimes no agreeable task to apply the mouth to that of another. In that case a flexible or a metallic catheter may be passed into the trachea, and tightly held there by the finger and thumb placed on the neck, while air is blown through it into the lungs. The only difficulty here is the getting the instrument into the larynx; but that is easy enough if the operator will only remember to take the precaution to push the larynx upwards and backwards, as before described, and then glide-in the catheter with its point tilted forwards. The catheter will be known to be in the trachea, and not in the œsophagus, by our capability of moving the larynx from side to side by its means.

Dr. Richardson† has proposed a 'pocket bellows' for artificial respiration, as represented in the accompanying woodcut.

Fig. 427.



It consists of two elastic hand bellows ending in a single exit tube. When the bellows are in action, the tube being inserted in the nostril, one ball (A), after exhaustion, becomes filled from the common air, and the other (B) from the air left in the air-passages. During compression, the air in the ball charged with common air enters the lungs, and the air in the ball charged from the lungs is driven into the atmosphere. Thus the precise conditions of natural respiration are imitated. The filling and emptying of the lungs is in the grasp of the operator, who can therefore fill or empty gently or forcibly, as he pleases. In using the bellows, it is good to begin by a gentle exhaustion, and the milder the force employed to fill the lungs, the better. Merely to excite thoracic movements is sufficient, and the moment there is spontaneous or natural breathing, it is best to cease the artificial process. In croup and other diseases where the air-passages are obstructed, and the patient is sinking from exhaustion of the muscles concerned in respiration, Dr. Richardson thinks these bellows may be employed with great benefit.

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* *Edin. Monthly Med. Journ.* July 1850.

† *Med. Times and Gaz.*, December 4, 1869.

In cases of apnœa from inflammation of the fauces, excited by drinking boiling-water, inhaling steam, or swallowing escharotic fluids, it is better, before attempting artificial respiration, at once to perform tracheotomy. For when the inflammation or disorganisation is sufficiently severe to prevent the entrance of air by the natural thoracic movements, it is not at all probable that artificial means will be more successful in surmounting the obstacle to its admission. The same remark is equally applicable to cases of diphtheria and croup.

In cases of attempted death by strangulation, the surgeon may be called upon to treat something else than mere apnœa. If much force has been employed in constricting the neck, there may be considerable injury done to the larynx. The os hyoides may be fractured; the laryngeal cartilages broken, especially in old persons, in whom they have become ossified; moreover, there may be contusion, and even laceration, of the soft parts of the neck. As an illustration to these remarks, the following case of impending apnœa arising from fracture and displacement of the os hyoides may be cited:

On March 28, 1856, a little girl, aged six years, while jumping, fell with her neck across the rail of an iron bedstead. She was instantly seized with a fit of coughing, great dyspnœa, an inclination to vomit, and a copious flow of saliva. The saliva was partly tinged with blood. When brought to us, which was almost immediately after the receipt of the injury, there was distressing difficulty in breathing, the face was of a livid blackness, and there were all the other symptoms of impending death by apnœa. On examining the neck, there was found a sharp body projecting beneath the skin. It was very angular and quite movable. On close inspection it was found to be the displaced ends of the fractured hyoid bone. One end of the body rode over the other. By a little manipulation the fracture was reduced, and all the symptoms of impending suffocation, together with the copious flow of saliva, &c. rapidly subsided. A bandage was placed round the neck to keep the ends of the bone in their place; and with the exception of a smart attack of fever, which lasted three days, the child made an uninterrupted recovery, and without any deformity except a slight fulness caused by the callus; but even this after a time disappeared.

Where there is much congestion of the vessels of the head and neck, bleeding has occasionally been had recourse to; and although it cannot be recommended as a means of removing apnœa, yet we see no reason for condemning it *in toto*, as some recent writers have done. On the contrary, although we would not advise it to be practised as a general rule, we nevertheless think that the abstraction of a moderate amount of blood from the right jugular vein may be sound treatment in certain cases of apnœa. It will have the advantage of relieving, for a time at least, the congestion in the vena cava superior, and thereby facilitating the contractions of the over-distended and thereby weakened heart. On opening animals immediately after death by apnœa, we have frequently seen the arrested heart's action recommence, and continue regular for at least a quarter of an hour after we had punctured the vena cava and thereby relieved the engorged cardiac organ of some of its blood. The heart is exactly like the bladder; whenever it is over-distended, it ceases to be able to contract upon its contents. In thus recommending bleeding from the jugular vein in certain cases of apnœa, we desire it to be distinctly understood that the abstraction of blood is only to be regarded in the light of an auxiliary to the other treatment, and to be in no case practised except in plethoric subjects; for, in those of an opposite constitution, all the blood they possess is required to carry them through the dangerous period of secondary apnœa.

It has been argued that if bleeding is serviceable at all, it ought to be particularly so in cases of strangulation and hanging, where urgent symptoms of cerebral congestion are frequently observed. No doubt this view is correct; but the bleeding must not be carried too far, for experience has taught that in these very cases, after the first insensibility has been temporarily recovered from, the bleeding has neither prevented the supervention of stertorous breathing, convulsions, coma, nor even death itself.

As regards treatment in cases of drowning, we desire to call special attention to the fact, that all persons who die in the water are not necessarily drowned. A man labouring under heart-disease may suddenly expire from the thoracic shock received in coming violently in contact with the surface of the water. Persons falling from a height have died from concussion of the brain and extravasation of blood under the arachnoid.

On the other hand, persons have died of apoplexy while bathing; and not long ago the brother of a medical man died from an epileptic seizure which was supposed to have come on during the act of diving. This occurred in one of our public baths, where he was in the habit of practising swimming. On the occasion in question he was seen to dive, as he usually did on first entering the water; but as he never rose again, a search was made, and his lifeless body was found lying at the bottom of the bath. The gentleman had suffered from epileptic attacks for several years.

While guarding against an error in treatment from mistaking epilepsy for drowning, one must be equally cautious not to fall into the opposite error of mistaking the convulsions of apnœa for those of epilepsy; for they may occur in cases of drowning, as well as in any of the other forms of death from cessation of the respiratory process.

As regards prognosis in cases of drowning. It may be laid down as a rule, that the more complete the submersion the more fatal the case; for after the person is completely submerged, frequent attempts at respiration continue to be made, with each of which air and frothy water are expelled from the lungs, and water enters. This goes on until the person is exhausted and all attempts at respiration cease. For example, a person completely submerged for one single minute and a half has a much slighter chance of recovery than one who has struggled about in the water for ten minutes or more, even although the former when taken out is still making efforts at respiration, and the latter has ceased to do so. Of course it is taken for granted that in the latter case the heart's action still continues, and the respiratory movements have only just ceased. The heart's action continues for from two to four minutes after respiration has stopped; and so long as the impulse of the heart is perceptible, resuscitation is not only possible, but probable.

By referring to the physiology of drowning, the grounds upon which this assertion is based will be at once evident. It may be added, as a second general rule, that the more rapid the cessation of the respiration in cases of drowning, the less is the chance of recovery—which is exactly the reverse of what happens after apnœa from mechanical obstruction. The reason of the greater likelihood of death after a rapid stoppage of the respiratory movements in drowning, is that it usually arises from a very sodden condition of lung; and in proportion as the lungs are sodden with water are the chances of recovery diminished. When the person has gone on struggling for some length of time, and occasional imperfect inspirations have been obtained, he at length sinks from the combined effects of exhaustion and apnœa, and the lungs are not then in the sodden condition met with in cases of entire and continued submersion. This, too, is the reason why the lungs of human beings seldom or never exhibit the excessively sodden condition met with in animals sacrificed for experiment.

The object of suspending drowned persons by the heels for a second or two is to permit of the exit of the water from the trachea and bronchi; and the plan is no doubt, in certain cases, a good one.

As regards the treatment of cases of apnœa from simple absence of oxygen in the inspired medium, we have no special remark to make, except that artificial respiration is the only treatment required.

While regarding the cases of semi-apnœa and semi-poisoning of the fourth group of the classification, we have to observe that, if possible, artificial respiration is more imperatively demanded in them than in any of the other cases we have hitherto been considering, for the simple reason that not only is oxygen required to be put into the circulation, but the poisonous gas to be taken out; and there is no readier means of attaining this object than by artificial respiration. All gaseous and volatile poisons are much quicker eliminated by the lungs than by any other channel. A most striking illustration of this can be given in the experiment first proposed by Bernard, and which we have several times repeated with results precisely similar to those obtained by its inventor.

Sulphuretted hydrogen, when inhaled, is rapidly fatal to animal life; whereas if, instead of allowing the gas to enter the circulation by means of the lungs, it be mixed with water and injected into the jugular vein, it fails to produce any toxic effect. And why? Merely because it is *exhaled* by the lungs during its passage through them, and it is thereby prevented from getting into the arterial current. So rapid is the exhalation of the gas, that if a fragment of white paper moistened with the acetate of lead be held in front of the dog's nose, within four seconds after the injection of the gas into the jugular vein, it reappears in the expired air; as is proved by the black sulphuret of lead which forms on the paper the moment the breath comes in contact with it.

This experiment is sufficient of itself to prove the value of artificial respiration as a means of eliminating volatile poisons from the circulation; so that it is unnecessary for us to enter into the question of the pulmonary elimination of ether, chloroform, or any other volatile vapour or gas; the results obtained by experiments being identical in all cases, as far as they have been yet tried.

In entering a place full of foul air, for the purpose of rescuing some one who has become insensible, a deep inspiration should be taken, and then the breath held the whole time the person is in the poisonous atmosphere; just in the same way, and for similar reasons, as a man fills his chest with air before diving, and holds his breath the whole time he is under water. It might be said that these views are still further supported by the facts discovered by the Committee of the Royal Medical and Chirurgical Society, namely, that while a dog submerged for a minute and a half without being previously chloroformised, dies, a dog, previously rendered insensible by chloroform, may be submerged for two minutes fifteen seconds, and yet recover. It is thus seen that by simply depriving the animal of the power of making voluntary respiratory efforts, the period during which submersion may be continued, and yet recovery follow, is at once prolonged.

It only remains for us now to put before our readers the general rules which should guide them in the treatment of cases of apnœa, the fundamental object of which is to arterialise the blood as rapidly as possible. The Royal Humane Society's rules are so admirably drawn up, that we have only to modify them a little in order to give to them the wider application demanded by the general question of apnœa.

Galvanism has been frequently proposed as an aid to recovery in cases of suspended respiration; but as the grounds on which its supposed benefits rest are somewhat vague, they need not be here entered upon. The advantages derivable from the remedy may be summed up in a very few words. In the first place, it is to be borne in mind that artificial respiration cannot be kept up by galvanic influence alone. Galvanism can only be employed as a direct re-exciter of normal respiratory movements and reawakener of the heart's action, when that organ has ceased to pulsate. For these purposes it is best employed in conjunction with artificial respiration; and is most readily applied by placing one pole in the upper sternal or lower cervical region, and the other immediately over the diaphragm. The galvanic shocks ought not to be too frequent nor too prolonged; and when they visibly fail to restore the normal respiratory movements and cardiac action, this agent ought to be laid aside, as its continued use tends to exhaust the vital energies.

RULES OF TREATMENT IN CASES OF IMPENDING DEATH BY APNŒA.

1. All froth and mucus, of which there is usually a considerable quantity, are to be immediately removed from the mouth and nostrils; and should the case be one of drowning, in addition to the removal of the mucus from the mouth and nose, the legs and trunk of the patient are to be raised for a few seconds above the head and shoulders, in order to allow of the exit from the trachea and lungs of any free fluids that may be present in them.

2. All tight articles of clothing are to be at once removed from the neck and chest. For example, the cravat is to be taken off, the shirt unbuttoned, the corset unloosened, &c.

3. Should it happen that the patient is already so nearly dead that his tongue sinks back into the fauces, and is thereby likely to interrupt the entrance of air into the trachea, it is to be drawn forward, and, if necessary, held there.

4. If the respiratory movements have ceased, or become few and feeble, artificial respiration is to be performed by manual pressure, or by the Silvester method.

N.B. In order to do this readily, place the patient on his back upon a flat surface, with the pillow or cushion under the shoulders, for the purpose of arching the back slightly; and if manual pressure is the method adopted, it must not be forgotten that the pressure is to be made simultaneously on the lower part of the chest and middle of the abdomen.

5. Should the apnœa be the result of mechanical constriction of the chest, as from a fall of earth or stones, by which one or more of the ribs may have been broken, the manual pressure and the ready methods are to be avoided, and artificial respiration by means of the Silvester method employed in their stead.*

6. As soon as natural respiratory movements recommence, cease the employment of artificial means, unless the efforts are feeble and imperfect, when they may still be aided for a time with advantage.

7. As soon as the patient is capable of swallowing—and sooner, if a stomach-pump is at hand—administer a cupful of warm coffee or tea, with a couple of drachms of spiritus etheris nitrici in it; or if that is not at hand, a tablespoonful of brandy or other spirit.

8. Use warm frictions all over the body, more especially on the limbs, to aid the circulation; and the more the skin is exposed to dry warm air the better, as even the cutaneous respiration aids in the arterialisation of the blood.

9. When the temperature of the body is much reduced, as in cases of drowning during the cold winter months, try and restore it by means of a hot-water or air-bath. If by the latter, place the head of the patient so as to keep the rarefied hot air from entering the lungs. Artificial respiration by pressure and frictions with the hand can both be readily applied while the

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* If there be sufficient assistance at hand, the Silvester method may be followed in all cases in which artificial respiration is considered necessary; but where the medical attendant is alone, the method by simple pressure is the quickest and easiest that can be adopted. It only differs from the Silvester method in this respect, that in it the air is forcibly expelled from the lungs, and allowed to enter, in consequence of the vacuum produced in the thorax by the re-expanding of the walls by their own elasticity; while in Silvester's method the air is forcibly inhaled and then expelled by the natural resilience of the ribs. In both cases the respirations should amount to twenty, thirty, or even forty per minute. The natural respirations are only eighteen per minute; but in cases of resuscitation, our object is to arterialise the blood even more rapidly than in health; and as we cannot introduce by artificial means the same amount of air that is taken in by the normal efforts, we must increase the number of our respirations.

body is in the warm bath.* The bath should not be too hot (not above 106° F.), as it is not desirable, for the reasons formerly given, to raise the bodily temperature above its normal standard. Nor should the body be retained in it after the temperature has been restored; for, as was before said, the more the skin is exposed to the air the better.

Treatment after the breathing has become natural.—1. Give the patient some warm nutriment, to which a small quantity of stimulant is added; beef-tea, chicken-soup, coffee, or simple tea with one or two tablespoonfuls of brandy.

2. Put him into a well-aired bed with hot bottles to his feet, and encourage sleep.

3. Let him be carefully watched during sleep in case of secondary apnœa; at the slightest symptom of which let gentle frictions and, if necessary, artificial respiration be again had recourse to. Give volatile stimulants, such as the spiritus ammoniæ aromaticus, or spiritus etheris nitrici.

In the case of the drowned, the following might be said to be the four golden rules of treatment:

1. Empty the air passages of all the water and frothy mucus they may chance to contain, by holding the legs and trunk higher than the head.
2. Wipe the mouth and nostrils dry.
3. Draw forward the tongue.
4. Use artificial respiration.

GEORGE HARLEY, M.D.

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* In the case of a young woman, one of the fourteen who were nearly drowned in the water at the Regent's Park a few years ago, in consequence of slipping into a hole in the ice, the body was so excessively cold, and the limbs so stiff, that as soon as she was brought into the tent which was being used as a temporary receiving-house, she was instantly put into a warm bath, without waiting to take off her clothes, and artificial respiration by manual pressure at once commenced. It was, however, found impossible to obtain any result with her stays on; so they were slit open, but not removed, and the artificial respiration at once recommenced. In about twenty minutes the patient was so far recovered as to be able to give her address. In this case, when brought into the tent, the girl appeared to us to be perishing as much from the effects of cold as from apnœa.

ON PARASITES, AND THE DISEASES WHICH THEY PRODUCE.

UNDER the term 'parasites' might properly be included all the organised beings which exist during a part or the whole of their life at the expense of other living animals or plants. In this sense an innumerable host of creatures would be included under the term, belonging to both the animal and vegetable kingdom. These have been divided into *true* and *false* parasites; and the former have even, by some writers been erected into a distinct class, or rather into distinct classes, under the names of ento- and epi- zoa, or ento- and epi- phyta; but, in a scientific point of view, it is obviously improper to maintain any such classification.

Parasitism is to be regarded more as an accident than as an essential attribute; and the mere circumstance that an organism lives at the expense of another living being affords no valid ground of distinction between it and others whose nutriment is derived from dead organic matter. It is, moreover, now universally admitted that all the so-termed entozoa, &c., belong to some one or other of the larger groups of non-parasitic forms already constituted in either kingdom. In the case, for instance, of parasitic animals, we find not only that they nearly all belong to the sub-kingdom Annulosa, but that they also fall into existing classes in it. The most that can be said of any among them is that they appear to constitute groups of ordinal value.

In any general account of the subject, therefore, parasites would have to be regarded in their relations to numerous closely-allied forms; and the study, consequently, would be one of very great extent. It is one also, from many circumstances connected with their life-history, of extreme interest both to the naturalist and the physiologist. Here, however, we have to do almost exclusively with the surgeon; and the limits and objects of an essay like the present preclude both the possibility and the necessity of considering the subject in any such extent. We propose, in the brief space at our disposal, to give an account only of those parasites the consequences of whose invasion are likely to be brought under surgical treatment; and in doing this to enter only so far into their natural history as may be necessary for the suggestion of curative or prophylactic measures.

Classification of parasites.—In the first place they belong either to the animal or vegetable kingdom. We will commence with the former.

A. Animal Parasites.

Arranged in zoological order, these are found in the following classes:

I. Infusoria.
II. Annuloida.
III. Arachnida.
IV. Insecta.

I. *Parasitic infusoria.*—Four or five minute organisms belonging to the heterogeneous group of *infusoria* have been described as occurring in the human subject. They belong to the families Monadina and Holotricha. The former includes all infusory animalcules presenting a simple and apparently homogenous body furnished at one end with one or more elongated vibratile filaments. The family, however, is a very doubtful one in its relations to the animal kingdom, and it is pretty certain that the majority, if not the whole of the monadina, merely represent the motile zoospores of various algæ or fungi. It is also extremely doubtful whether they should in any case be regarded as parasites, and not rather as merely the concomitants of putrefaction.

The supposed parasitic Monadina belong to the genera *Cercomonas* and *Trichomonas*; the former, characterised by the presence of a single vibratile filament, and the latter by that of two or more. The species of *Cercomonas* noted as parasitic are, *C. intestinalis, C. urinarius*, and *C. saltans.* The situations occupied by two of these forms are sufficiently indicated in their names, whilst the last is described as occurring in the discharge on the surface of foul sores; but its occurrence must be very rare, to judge from our own observations.

The only species (*T. vaginalis*) referred to the genus *Trichomonas*, presents points of rather more interest. Originally noticed by M. Donné* in the mucus of the vagina, he at first supposed it to be diagnostic of a gonorrhæal discharge, but subsequent observations by himself and others have shown that this is not the case. In fact, according to Kölliker and Scanzoni, it was found in the majority of the women examined by them, either pregnant or not. Its presence would appear, nevertheless, always to be accompanied by some morbid condition of the vaginal secretion, though that need not be exclusively of a specific nature. It is to be remarked, moreover, that its habitat is exclusively the vagina, as it is never found even in the cervix uteri. The animalcules vary in length from $0^{m}\cdot008$ to $0^{m}\cdot018$, and they are usually furnished, in addition to the whip-like appendages, with a few cilia at their base. In their natural nidus they exhibit active movements, which, however, soon cease on the addition of water, in which they swell up into a spherical form, and assume very much the appearance of ciliated epithelium-cells, for which they have sometimes been mistaken.

In the family Holotricha, among the true ciliate infusoria, the only parasitic form observed, if it really deserve the name, is a species of *Paramæcium* described by Malmsten as occurring in the cæcum and colon.

II. *Parasitic Annuloida.*—Dividing the Annulosa into three primary groups or provinces, viz. the Arthropoda, Annulata, and Annuloida, we shall find that all the more important parasites belong to the first and last, which alone includes almost all the true entozoa. In the arthropoda, the classes arachnida and insecta both afford instances of occasionally or permanently parasitic species; whilst in the annulodia, or most lowly organised division, in which we include the scolecida, gephyrea, echinodermata, and rotifera, they are found only among the first. The orders included in this class are,

1. Tæniada	Platyelmia.
2. Trematoda	
3. Turbellaria	
4. Acanthocephala	Nematelmia.
5. Nematoidea	
6. Gordiacea	

With the exception perhaps of the Turbellaria, all these orders may be regarded as composed of parasitic creatures.

(*a*) *Platyelmia, or flat worms.*—The members of this sub-class are characterised by a more or less flattened body, usually very short, but in some cases, as among the Turbellaria, of considerable length. They are generally furnished with external appendages for the purpose of motion or of attachment, and consisting in some cases of suctorial discs or acetabula, in others of hooks of various kinds, or of both combined. Most of them are hermaphrodite, and in many the course of development presents strange and peculiar phenomena. With respect to their organisation, it may be stated generally that the platyelmia have no proper visceral cavity, the body being composed as it were of a solid parenchyma, in which the viscera and muscular tissue are closely imbedded. On this account some among them have been termed sterelmintha. Considerable diversity exists in their alimentary system; for while some have a complete canal with oral and anal orifices, and a protusile pharynx, in others the anus is wanting, and the mouth a mere pore, and in some, which are endoparasites throughout their existence or nearly so, no trace of mouth or alimentary canal exists; the nutrition of the worm being carried on through the external surface. None possess any true blood-vascular system; but in all there is a distinct system of so-termed 'water-vessels,' probably of a renal or excretory nature, and which in some pervades the entire body with its fine reticulations, in the ultimate extremities of which are lodged minute calcareous or phosphatic particles. The nervous system is either wholly inapparent or very rudimentary.

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* *Recherches Microscopiques ;* Sur la nature du mucus, 1837, and Cours de microscopie, 1847, pp. 157–161, fig. 33.

Tæniada,—Tape-worms.—In this order, which has sometimes received the name of Cestoidea or Cestoda, are included also the so-termed Cystica or cyst-worms, the reason for which will be apparent from what follows. In addition to the characters they possess in common with all the platyelmia, the Tæniada may be distinguished by the following. They have neither mouth nor intestine; and in the mature or sexual condition are united into a continuous band or chain, originating in an individual or zooid, which itself never reaches sexual maturity, but continues to throw off a succession of buds or gemmæ, each of which becomes a perfect hermaphrodite individual, though remaining attached to the colony, of which it forms a link, for a considerable length of time. The separate zooids constituting this compound growth or *strobila* become more and more developed as their distance from the primary joint increases, until, having reached full maturity, they are successively detached, either spontaneously or accidentally, and pass out of the body with the fæces. The primary zooid remains all the time attached to the intestinal mucous membrane of the host by one or other of the organs mentioned above. This individual is termed a *scolex*, and each separate joint or sexual zooid budded from it a *proglottis*. This is the condition of the entozoon when it forms what is termed a *Tænia*, or tape-worm, which consequently must be taken to represent a chain or continuous succession of distinct zooids gradually arriving at sexual maturity, and then thrown off. In this state it is always found within the intestinal canal, or, as in some fishes, in diverticula from it. In another condition, however, the tænioid entozoa are invariably found in the parenchymatous tissues of the body external to the intestinal tract; but here they exhibit a totally different aspect, constituting, in fact, the so-termed *cystica*, or cyst-worms. It is also a remarkable circumstance that, so far as is known, with the exception of the human subject, the tænioid and the cystic states of the same species are never found in the same animal. The cyst-worms of one animal give rise to tape-worms in another, and *vice versâ*; and what is equally remarkable is the fact that these are in almost all cases reciprocally herbivorous and carnivorous or omnivorous species. As, for instance, the cyst-worm of the sheep or rabbit will produce tape-worms in the dog and cat; those of the pig and ox become tape-worms in man, &c. This curious state of things arises in the following way: The mature proglottis of the tænia is filled with ova, each of which, within a firm and peculiarly resistant shell, contains a minute active embryo, which from its being armed with six hook-like boring implements, has been termed a 'six-hooked embryo,' or 'hexacanthus.' For the exclusion of this embryo, it appears, from repeated observations and experiments, to be necessary that the ovum should be subjected to the solvent action of the gastric juice in the stomach, usually of another species of animal than that in which the proglottis was nurtured. But when thus liberated from its durance the 'hexacanthus' speedily makes its way through the walls of the intestine of its new host, and effects a lodgment in the tissues of the body, after a migration of greater or less extent. Having reached its ultimate destination, the hooks are thrown off, and the embryo is transformed into a cyst-worm, which differs according to the species of tape-worm from which it originated. This is the general mode of proceeding in the tæniada; and it will consequently be seen how the cystica, which were formerly regarded as a distinct class, are nothing more than one phase in the life-cycle of the tæniada. The only apparent exception, as yet observed, to the rule, that for the exclusion of the active embryo the ovum containing it must pass through the stomach of an animal, is that of *Bothriocephalus latus,* in which it would appear that the embryos are capable of living in water, after escaping from the ovum, in the form of a ciliated infusorium or planula; and it is a curious circumstance that in this species the egg-shell is furnished with a sort of movable lid, to facilitate the escape of the embryo.

The various forms of cyst-worms have received the generic names of *Cysticercus, Cœnurus, Echinococcus,* and *Anthocephalus*; and it is with the tæniada in this phase only that we have here much concern, the tape-worms themselves coming more properly under the notice of the physician.

The following species of tæniada are enumerated by Dr. Cobbold * as having been met with in the human subject; some are perhaps apocryphal. Opposite the name of each tape-worm or 'strobila' we have given (when known) that of its cystic representative.

1.	Tænia solium . . .	Cysticercus cellulosæ.
2.	,, mediocanellata . .	,, t. medio-canellatæ.
3.	,, acanthotrias	
4.	,, flavopuncta	
5.	,, marginata . .	,, tenuicollis.
6.	,, echinococcus . .	Echinococcus, Acephalocyst, &c.
7.	,, nana (Siebold)	
8.	,, elliptica	
9.	Bothriocephalus latus	
10.	,, cordatus	

1. The cystic scolex of the common tape-worm is the *Cysticērcus cellulosæ* of authors. The most usual habitat of this species is the muscular tissue of the pig, which when thus affected is said to be 'measly.' It is frequently met with, however, in other situations and in other animals, especially in man. It is distinguished by its quadrangular head, short neck, thickened anteriorly, its long cylindrical body, and elliptical caudal vesicle, which, when the worm is lodged in the muscles, has its long diameter in the direction of the fibres. Nothing very positive is known respecting the earliest stages of the development of the 'six-hooked embryo,' as it does not appear by any means quite certain that the peculiar elongated cysts in muscle first noticed by Hessling, and afterwards more fully described by Mr. Rainey,† have any actual relation to this *Cysticercus.*

In the earliest stage at which it has been positively made out the worm is about 1 millimètre in length, and nearly spherical in shape. It is formed at this time simply of a minute vesicle, whose walls exhibit a distinct and rich plexus of vessels, within the smaller branches of which vibratile tags are visible, whilst the interior of the vesicle is filled with a clear fluid. On one part of the wall the rudiment of the head or future scolex may be seen as a small opaque spot. The development of this part gradually proceeds, until at length it attains its full size, and projects into the interior of the enlarged cyst, invaginated, as it were, in a sac formed from the internal layer of the cyst. At first the 'head,' is straight; but as it increases in size it becomes bent at nearly a right angle, and eventually at its lower or inner extremity the characteristic acetabula and hooks of the tænia make their appearance. The entire course of development up to the completion of the cysticercal condition appears to require between two and three months. How long the parasite may remain in this stage within the tissues of its host is unknown, though it would appear from the observations of Stich * not to exceed a few years at most.

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* *Proceed. Zool. Society,* 1862, p. 289.

† *Phil. Trans.* 1857, p. 111.

Though comparatively rare among ourselves, it seems that in some countries the occurrence of *Cysticercus cellulosæ* as a human parasite is by no means uncommon. This difference it is not easy to account for, unless, with Leuckart, we admit the possibility of self-infection from the ova of the tape-worm, and consequently that a difference in habits of cleanliness or care may be followed by corresponding consequences. It is not improbable, however, that a greater frequency of occurrence of *Cysticerci* in the pig in any country will lead to a greater frequency of occurrence of the tape-worm in man; and the more especially so, when, as is the case in many parts of Germany, large quantities of pig's-flesh in an almost uncooked or raw state are consumed. As a proof of the frequency of *Cysticercus cellulosæ* in certain districts, we may mention that Rudolphi states that in his experience it was met with in about one body in fifty-six of those brought into the dissecting-room at Berlin; and it would seem that in many parts of Germany scarcely a year passes in any anatomical school without instances of its occurrence. These instances, however, have for the most part only been discovered after death; the presence of the parasite when lodged in the muscular tissue being, except in rare cases, apparently unattended with any symptoms.

The comparative frequency of *Cysticercus* in the different organs or tissues may be stated in the following order:

The muscular tissue, or rather perhaps the inter-muscular connective tissue; the brain and eye; heart; lungs; liver; and, more rarely, the kidney and lymphatic glands. The spleen, and even the osseous tissue, according to Stich, are not exempt from its invasion; though with respect to the latter situation at any rate considerable doubts of its occurrence may reasonably be entertained. It may be observed, also, that in cases where *Cysticerci* are found in the muscular tissues, they usually exist in vast numbers; whilst in cases where they occupy other situations, they are usually few in number, or even solitary. As regards the human subject it has been suggested by Leuckart † that where the parasite has been found in considerable numbers, it has been in cases of what may be termed self-infection conveyed by the passage of a tape-worm or of a proglottis, or it may be of some ova alone into the stomach. The not infrequent concurrence of *Cysticerci* in the tissues with tape-worms in the intestine affords, as he remarks, a strong proof of this. Von Gräfe relates that of thirteen individuals treated by him for *Cysticerci* in the eye, five were also infested with tape-worm. The fact, at any rate, points to the necessity of care, in persons so affected, not to infect themselves with the mature ova either externally or internally. For it is not improbable that the 'hexacanthus' may be liberated from the ovum by mechanical violence as well as by the solvent action of the gastric juice; and when thus liberated, it may be capable of making its way as easily through the membranes of the eyeball as of the intestine.

With respect to the symptoms produced by *Cysticercus cellulosæ*, it has been already said that when confined, as is most usual, to the muscular or subcutaneous connective tissues, the parasite appears to be wholly innocuous. The power even of the affected muscles is not notably impaired; and this is the case, it would seem, with the heart as elsewhere. Nor do the adventitious cysts in which the worm is lodged seem to be liable to spontaneous inflammation, though instances are recorded of their becoming inflamed and suppurating in consequence of pressure or external injury in exposed situations; as on the extremities, nates, &c.

It is far otherwise, however, when the entozoon has penetrated into the eye or brain. Passing over, here, the symptoms arising from its presence in the latter situation, we will refer more particularly to the morbid phenomena produced by it in the organ of vision. For our knowledge of this subject we are chiefly indebted to Professor von Gräfe, who seems to have enjoyed abundant opportunities of studying it. His papers will be found principally in the *Archiv fur Ophthalmologie* for 1857. In the eye the *Cysticercus* presents itself in two different conditions, free and encysted. The former occurs only in the aqueous chamber, or in the crystalline body, or rather its capsule; and it is considered probable that these free embryos have escaped into those situations from cysts originally lodged in the coats, and especially in the iris or choroid. Occasionally, however, when in the crystalline lens, the vermicule becomes surrounded with a secondary cyst. The changes and injurious effects produced vary, of course, according to the situation occupied by the *Cysticercus*. In the subconjunctival connective tissue its presence is rarely manifested by any symptom beyond occasional slight conjunctivitis. But when lodged in the aqueous chamber the consequences are more important; for not only does it directly hinder the free passage of the rays of light, but the irritation caused by it is often accompanied with a chronic inflammation of the surrounding membranes. And its effects when in the deeper parts of the organ are still more serious. Here it may be lodged, enclosed in a capsule, either beneath the retina or in the vitreous humour. It is probable that it always makes its way through the retina to reach the latter situation. The presence of the parasite on or near the retina and choroid induces chronic inflammation and disorganisation of those important parts, eventually leading even to total blindness.

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* *Annal. d. Charité Krankenhauses*, 1854, p. 170.

† *Mensch. Parasit.* p. 281.

The objective signs of the presence of a cysticercus in the eye are extremely obscure without the aid of the ophthalmoscope. But with the aid of that instrument the parasite may be detected in the bottom of the globe, where it appears in the form of a light-coloured or semi-transparent vesicular swelling, whose position with relation to the retina may, in some cases, be determined by the appearance of the capillary vessels. When the cyst is covered in front by the retina, the vessels of that coat will be seen coursing over the little swelling; but when it is lodged in the vitreous humour or on the inner surface of the retina, the vessels, it is said, will be seen to terminate suddenly as they pass behind the tumour. The prognosis, in most cases, will be more favourable in the latter case than in the former.

2. *T. echinococcus.*—Another and far more familiar tænioid entozoon is that of which the *Acephalocyst* and *Echinococcus* represent the cystic and scolecid conditions. The tænia or strobila of this species is at present known to occur only in the dog and wolf. It is of small size, and usually exists to the number of many thousands among the villi of the small intestine, where the tæniæ are rendered apparent by the white colour of the mature proglottides.

The ordinary form in which this entozoon occurs in the human subject is that of a semi-transparent globose vesicle, with highly-elastic laminated walls, lined with a finely-granular layer, and which is lodged, sometimes in great numbers together, in the parenchyma of the liver, lungs, or other solid viscera, or in the connective tissue in almost any part of the body, usually enclosed in a distinct capsule formed by exudation into and the consolidation of the surrounding tissue. The interior of these cysts is filled with a clear watery fluid, in which may sometimes, but by no means always, be seen floating a few or many tænia-heads, or scolices, the so-termed *Echinococci.* Sometimes, however, the only remains of these will be the minute hooklets with which they are armed. But though usually met with in this detached condition, these heads in the recent and perfect state of the cyst will be found adherent to its inner wall, or granular layer, to which they appear to be attached by a short peduncle. When so attached, they are seen through the transparent walls of the acephalocyst as minute opaque or whitish specks. It more often happens, however, and as it would seem especially in the human subject, that numerous acephalocysts may be examined without the discovery of a single echinococcus-head.

Hydatid cysts are capable of multiplying themselves in other ways; and it is to this property that their destructive power is mainly due. Although an individual cyst may singly attain to enormous dimensions, it is more from their rapid and continued propagation that the large hydatid tumours, and consequent great mischief caused by them, are produced. This multiplication takes place by what may be termed a sort of gemmation or prolification in the walls of the cyst; and it is effected in two or three different ways. (1.) The secondary cysts arise in the substance of the walls of the parent hydatid; and when they have reached a certain size become detached, and are then capable of independent growth, and of again themselves throwing off similar buds; and so on *ad infinitum.* (2.) The secondary cysts may be protruded and thrown off either on the exterior or into the interior of the parent vesicle. In the former case we have the exogenous form of hydatid, or the *E. scolecipariens* of Küchenmeister; and in the latter is produced the well-known endogenous or 'pill-box' hydatid of authors. Both forms occur in the human subject, though the latter by far the more frequently; and they may both even be found in the same subject. In either case the multiplication is sometimes carried to an enormous extent, and yet in the whole number of hydatids not a single Echinococcus will be found. Professor Leuckart mentions a case of a woman about sixty years of age who had a tumour for many years, which was supposed to arise from an extra-uterine fœtation, but on examination after death was found to be caused by a colossal acephalocyst springing originally from the liver, but which had gradually filled the abdomen with a sac weighing with its contents about thirty pounds. In its interior were many thousands of secondary cysts, from the size of a pea to that of the fist; but not a single 'head' or hooklet was anywhere discernible.

Acephalocysts with several hundreds of secondary cysts are not uncommon; but usually the number of the latter is under a hundred, and generally perhaps from twenty-five to fifty.

(3.) A third modification in the mode of development, or rather of multiplication of hydatids, has been described under the name of *E. multilocularis.* In this form the cysts never attain to anything like the dimensions of the two former, rarely exceeding those of a millet-seed, or at most of a pea. But though of these small dimensions, the cyst is capable of producing compound growths of considerable size, consisting of aggregations of vesicles imbedded in a common stroma. When a mass of this kind is cut across, it presents in the interior innumerable minute cavities of irregular form, separated by condensed connective tissue, and containing a tolerably transparent gelatinous material. Running amongst them may be seen the atrophied remains of the bile-ducts or blood-vessels, &c. Growths of this kind have hitherto been observed only in the liver; but as there appears to be no reason why they should not occur elsewhere, it may be useful to advert a little further to them. The alveolar structure and the gelatiniform nature of the contents of the cysts naturally led observers at first to suppose that they constituted a form of colloid cancer, the occasional presence of echinococcus-heads or hooklets being deemed a merely accidental complication. Virchow,* however, has clearly pointed out the correspondence between the so-termed colloid masses and minute echinococcus-cysts. His observations have since been amply confirmed by Professor Leuckart,† who has fully satisfied himself that all the cysts, down to the smallest, present the well-known characters of the common acephalocyst. He, moreover, ascertained that the echinococcus-heads contained in them were identical with those found in the usual hydatids, and that the multiplication of the cysts followed the type of *E. altricipariens.*

The connection between the hydatid cysts and the tænia, from which they are derived, hardly requires to be here pointed out, after what has been said on the general mode of development of the tæniada. The strobila in the intestine of the dog throws off proglottides containing the mature ova, which, on passing into the stomach of another animal, liberate the enclosed embryos, which make their way through the walls of the intestine, penetrating either directly into the contiguous connective tissue, or into the blood-vessels, by which they may be conveyed through the branches of the portal system into the liver, or through other channels into all parts of the body. Hydatids consequently, even to a far greater extent than *Cysticerci*, may be found in any part and in any of the tissues, including the bones themselves. In some respects, however, the two forms of cystic worms seem to affect different tissues by preference. The most common seat of the *Cysticercus* is, as has been said, the muscular system—a situation in which acephalocysts rarely occur. The eye and brain, also, are more rarely invaded by acephalocysts than by *Cysticerci*. By far the most common situation for hydatids in the human subject is the liver. In other situations, out of nearly 200 cases, Professor Leuckart states that in about 40 the lungs were the seat of invasion; in 30, the muscular and subcutaneous connective tissue; in 30, the kidneys; in 26, the lower pelvis; in 20, the nervous centres; in 17, the bones; and in 10, the heart. In the remaining 17 the parts invaded were the orbit, eyeball, mouth, thyroid body, walls of uterus, &c. In general, in man, hydatids are confined to a single locality, though this is by no means always the case.

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* *Das alveolar Colloid der Leber,* Tübingen, 1854.

† Op. cit. p. 373.

The frequency of occurrence of hydatids appears to vary much in different parts of the world. In this country, and in Europe generally, they are but rarely met with; whilst in Iceland it would seem that one-fifth or one-sixth of the entire population suffers from their invasion. In any case the poor appear to be more often affected than the rich—a circumstance easily explicable by their different habits.

The growth of hydatid tumours, when, from their external situation or from other circumstances, their existence is early manifested, appears to be extremely slow. Thus Velpeau removed a hydatid tumour from the axilla, which in six months had only reached the size of a walnut; and, in another case, the tumour had attained the size of the fist in about a twelvemonth. The endogenous or 'pill-box' hydatid is probably slower of growth than the other varieties, although in process of time it may acquire far greater dimensions. The ill effects of a hydatid growth vary, of course, according to its site. The more important situations in which tumours of this kind present themselves to the surgeon's notice are in the liver, eye, bones, and in external situations in any part of the body. A not unfrequent situation, also, is the lower pelvis, where by its growth the tumour may so far impede the functions of the bladder, uterus, or rectum, as to call for operative interference. The diagnosis, however, of such cases is extremely difficult, as similar symptoms may, as is obvious, arise from tumours of almost any kind in the same situation. The distinction, perhaps, might be drawn more from collateral circumstances or negative proofs than from any positive symptoms. When developed in the interior of a bone, the signs of a hydatid growth would be equally obscure until the tumour had reached considerable dimensions, or an exploratory opening had perhaps been made.

When it occurs in the eye, the effects of an acephalocyst would be much the same as those produced by a *Cysticercus*, except that as the growth of the latter is far more rapid, the ill consequences of the parasite are slower of development in the one case than in the other. The distinction during life, however, would be extremely difficult, and of no practical importance.

Although the duration of hydatid tumours is generally very prolonged, in fact lasting for the whole of life, it not unfrequently happens that they die, as it were, at an early period, and either cause suppuration, and are thus discharged, or become cretified and wholly innocuous.

The best treatment of a hydatid tumour appears to be that of making a free opening into it, so as to give exit to the contents and a vent to any subsequent discharge. In cases of hydatid tumour of the liver, it has been proposed, and the proposal has been occasionally carried out with success, to make the incision at two intervals in cases where there was reason to suppose that no adhesion existed between the wall of the abdomen and the coverings of the cyst. But in the majority of cases it will, perhaps, be better to wait until there is fair reason to conclude that adhesion has been set up. The injection of the cysts with various solutions, as of iodine, perchloride of iron, nitrate of silver, &c. has been practised; and some have thought with good effect. As the wall of the cavity containing the acephalocysts is in some respects analogous to those of a chronic abscess, the closure of the cavity when emptied will take place in the same way as in the case of an abscess.

None of the other species of Tæniada infesting man require any observation here.

II. *Trematoda.*—The Trematoda, in many respects allied to the Tæniada, differ from them in the possession of a distinct alimentary canal, with a mouth, but without any anal opening. They are also always solitary, and never associated into compound growths. They are for the most part hermaphrodite, though in some cases the sexes appear to be distinct. As in the Tæniada, the vitellus is furnished by a distinct vitellarium. In the course of their development, the Trematoda, like the Tæniada, present several phases, and require for its completion to migrate from one animal to another. Unlike the Tæniada, however, with the probable exception of *Bothriocephalus,* the larval forms of the Trematoda are enabled to live, probably for a long time, and to enjoy active powers of locomotion, external to the body of an animal, into which also they are capable, in many cases, of making their way through the integuments. They thus form, as it were, a link between the parasitic and non-parasitic scolecids, having relations on one side with the Turbellaria, and on the other with the Tæniada. The course of development of a trematode may be thus briefly described: from the ovum, generated in the mature fluke, is produced a ciliated embryo or planula, which, after remaining in the water for some time, is converted into an elongated vermiform creature, sometimes termed a 'redia,' which, in some cases possesses a tolerably well-developed alimentary tube and a distinct opening for the exclusion of the young; whilst in others it is reduced to a simple elongated tube, with no visible trace of internal organisation, and immobile. Within these rediæ or cercaria-sacs are produced, by a sort of internal gemmation, numerous minute tadpole-like creatures (*Cercariæ*), which, when liberated, swim actively about until they meet with a suitable 'host,' into which they bore their way, casting off the now useless caudal appendage.

Although some such cycle as this has been clearly traced in several species of Trematoda, nothing of the kind has as yet been ascertained with respect to those infesting the human frame. It is only from analogy that these have been supposed to undergo similiar changes. Whether the sheep, in which the liver-fluke is so extremely frequent, become infected by swallowing with the grass they feed upon snails into which the cercariform larvæ of a Distoma had entered, or whether they receive the Cercariæ in the water they drink, as is perhaps more likely, has not as yet been made out. Nor is there anything further known as to the mode in which flukes enter the human body.

About nine species of trematode entozoa are recorded as occurring in the human subject:*

1. Fasciola hepatica, Linn. (Distoma hepaticum, Aut.)
2. Distoma lanceolatum, Mehlis.
3. „ crassum, Busk.
4. „ opthalmobium, Diesing.
5. „ heterophyes, Von Siebold.
6. Bilharzia hæmatobia, Cobbold.
7. Tetrastoma renale, Delle Chiaje.
8. Hexathyridium pinguicola, Treutler.
9. „ venarum, Treutler.

Fortunately, however, most of this formidable list are of very rare occurrence, and the majority have been met with only once or twice. One or two only among them offer any points of interest to the surgeon.

(1.) *Fasciola hepatica.*—The common liver-fluke of the sheep has been met with in the human body less rarely perhaps than any of the rest; but even of its occurrence not more than nine or ten cases are recorded. It was found in the gall-bladder by Mr. Partridge; and in the liver itself, or more probably in the biliary ducts, by Bidloo, Wepfer, Pallas, Brera, and Mehlis; in the duodenum, by Brera; and several together in the portal vein and its branches, by M. Duval. Three apparently well-proved cases of the occurrence of the liver-fluke in subcutaneous abscesses have been recorded. In one instance, related by Giesker and Frey,* the abscess was in the sole of the foot; in another, related by ourselves,† a living *Fasciola* was extracted by Mr. Charles Fox, of Topsham in Devonshire, from an abscess behind the right ear. A third case is reported by M. Dionis des Carrières,‡ in which the fluke was extracted from a tumour in the right hypochondrium. The swelling was about the size of a pigeon's-egg, and excessively painful, hard, and at first deep-seated. A fourth instance of the same kind, but perhaps not so thoroughly authenticated in all respects, though we ourselves see no reason to doubt it, was communicated to Prof. Owen by Dr. J. Penn Harris of Liverpool.§ In this instance several flukes were said to have been found in an abscess under the scalp. One peculiarity in all these cases consists in the tendency the abscesses showed, after they had been opened, to close and become refilled.

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* Dr. Cobbold, *Proc. Zool. Soc.* 1862.

(2.) *Distoma ophthalmobium*, Diesing (*Monostoma lentis*, Nordmann). In the eyes of several species of fish a peculiar trematode parasite, termed *Diplostomum volvens*, was discovered by Von Nordmann, and has been excellently described and figured by him.‖ Prof. Jüngken ¶ extracted a lens in a state of incipient cataract, in which he found eight minute trematoda, which were referred by Von Nordmann to the genus *Monostomum.* And Gescheidt** found in the eyes of a child five months old, affected with congenital cataract, between the lens and its capsule, four specimens of a *Distoma* ¼ to ½ a line in length, some of which exhibited signs of vitality thirty-six hours after the death of the child. Dr. Cobbold considers that 'all these circumstances render it probable that the worms extracted by Professor Jüngken were specifically identical with those removed by Gescheidt.'

What relation these trematoda have to that of the fishes' eye, or what their origin and life-history may be, is at present wholly unknown.

(3.) *Bilharzia hæmatobia.*—This minute filiform species, which is not more than three to four lines in length, is distinguished among its congeners by its being bisexual. It appears to be extraordinarily abundant in Egypt, having been noticed by Griesinger 117 times in 363 bodies. Its primary habitat seems to be in the portal-venous system, and it is especially common in the minute veins in the walls of the urinary bladder. Its presence in the latter situation is indicated after death by circumscribed patches of inflamed and thickened mucous membrane, and by tenacious viscous grayish-yellow exudations, in which the ova of the entozoa are lodged. The ova are also sometimes found free in the urine, and thus afford a ready means of diagnosis. The vascular spots are sometimes raised into pedunculate excrescences one to three lines high, and having a fungous or verrucose appearance. The inroads of the worm are, however, not always limited to the bladder, but may extend to the ureters, or even as far as the pelvis of the kidney itself. When the ureters are affected, the thickening of the submucous tissue may produce such a constriction of the canal as to cause retention of urine above it, and thus to lead to dilatation of the pelvis, and ultimately to disorganisation of the gland. The aggregations of ova not unfrequently also constitute the nuclei of calculous

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[*] *Mittheilungen der Naturforschender Gesellschaft in Zürich*, 1850, ii. p. 89.

[†] Küchenmeister, *Manual of Parasites* (Sydenham Society's translation), vol. i. Appendix, p. 434.

[‡] Davaine, *Traité des Entozoaires*, p. 320.

[§] Küchenmeister, op. cit. Appendix, p. 435.

[‖] *Mikrographische Beiträge*, p. 28, pl. i. figs. 1-3.

[¶] Küchenmeister, *Manual*, &c. vol. i. p. 245.

[**] Ammon, *Zeitsch. f. Ophthalmol.* iii. No. 4.

deposits; and this appears to be the nature of the lithiasis of the Egyptians, described by Prosper Alpinus.*

It is proper here to notice a peculiar cutaneous affection, occasionally very prevalent amongst British troops in India, and more especially at Delhi, whence the affection in question has been named the 'Delhi-boil,' though not in reality having any furuncular character whatever. It is not, however, confined to that city, having been observed in many other and widely remote localities, as in Scinde, and at Lahore, Agra, Meerut, Roorkee, Mooltan and elsewhere.

Though well known, and often discussed, the true nature of this affection has hitherto never been satisfactorily explained. But in the *Report of the Army Medical Department* for 1868 (pp. 319-321) are two papers, by Staff-Assistant-Surgeon J. Fleming and Staff-Surgeon-Major A. Smith, whose observations strongly tend to show that the 'Delhi-boil' is caused by the invasion, probably, as suggested by Mr. Smith, through the sudoriparous pores, of a parasitic organism; and it would seem by no means improbable that this may be referred to some species of *Distoma* or other Trematode, in the cercariform or embryonic condition. Furthermore, it appears to be pretty conclusively shown that the parasite is conveyed through the medium of the well or tank water used for the purposes of ablution. A remarkable circumstance corroborative of which is cited by Mr. Smith in the fact 'that scarcely a single dog belonging to the military which may have been for any length of time in Delhi, escapes contracting the disease on the tip of the nose. The affection, as described by Asistant-Surgeon Fleming, 'is a morbid growth affecting the skin and subcutaneous tissue, which after a time ulcerates, but is unattended, until ulceration has commenced, with any inflammation. It commences very like a mosquito bite, the little red spot increasing slowly in size with a well-defined border, and raised above the surrounding skin. The growth continues to spread for two or three weeks or more, and as it progresses it becomes more elevated and covered with tortuous dilated vessels. A vesicle at length forms at the summit which discharges a pale yellowish serous fluid. Ulceration then commences and proceeds centrifugally until the whole growth is destroyed. The ulceration sometimes even extends to the neighbouring structures, and if the ulcer is situated near the eyes, nose or lips, those parts will almost be sure to be destroyed or materially injured, not excepting the cartilages of the nose. During the growth of the tumour it has a transparent and shining aspect, and if examined with a lens exhibits one or more yellowish spots, deeply seated about the centre of the tumour. If one of these spots be cut down upon with the dissecting needle, a small circular yellowish body with a glistening capsule may be easily removed.

Dr. A. Smith describes the affection rather differently, but there is no difficulty in reconciling his description with that above given.

From the description and figures contained in these two interesting reports it is impossible to come to any positive determination respecting the true nature of the supposed organisms found in the 'boils,' but the subject is one well deserving investigation; for should the views of Surgeons Fleming and Smith be confirmed, there could be no difficulty in the devising of such prophylactic measures as should entirely, or almost entirely, prevent the occurrence amongst our troops of this troublesome, and, as it would seem, sometimes serious malady.

(*b.*) *Nematelmia.*—The nematelmia, or round worms, although, from certain points in their organisation, more particularly with respect to the circulatory and nervous systems, very distinct from the annelida proper, nevertheless approach that class far nearer than do the platyelmia, than which they are much more highly organised. The body, which is always elongated and cylindrical, does not consist of a solid parenchyma with the viscera simply imbedded in it, but contains within a distinct integument a true perivisceral cavity, in which the alimentary and reproductive organs float freely. Within the integument also, and closely attached to it, are usually longitudinal muscular bands, which enable the animal to perform various and active movements. In most of the nematelmia also the alimentary and reproductive systems exhibit a considerable advance. The former consists in all cases of a distinct tube, usually subdivided into a pharynx or œsophagus, stomach, and intestines, and in most furnished with a mouth and anus, though in some few instances, as in the Gordiacea, the latter may be wanting. The mouth is sometimes armed with hooks, or other horny parts; sometimes quite simple. As regards the reproductive system, the sexes are always distinct, although the male and female organs are for the most part formed on the same common type. In both sexes the reproductive organ is represented by a long slender tube, in which, in the female, may be distinguished an ovary, Fallopian tube, uterus, vagina, and vulva; corresponding to which in the male we find a testicular portion, a vas deferens, a sort of vesicula seminalis, and an ejaculatory portion or duct, and in many cases an intromittent organ or penis. In the male the genital tube appears invariably to open at the hinder extremity of the body; whilst in the female the vulva may be in almost any part, and is very often to be found about the middle of its length. Impregnation is internal, and many species are viviparous. In one case only (*Trichina*) does anything like migration from one animal to another appear to be necessary for the development of the species. In some instances the male and female are alike in size and form; but in most they differ considerably in both respects, the male being sometimes immeasurably smaller than the female.

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* Küchenmeister, Op. cit., &c. vol. i. p. 285.

Numerous entozoa belonging to this sub-class have been mentioned as occurring in the human subject, of which the following is a list:

1. Ascaris lumbricoides, Linn.
2. „ mystax, Rudolph.
3. Trichocephalus dispar, Rudolph.
4. Trichina spiralis, Owen.
5. Filaria medinensis, Gmelin.
6. „ lentis, Diesing.
7. „ bronchialis, Rudolph.
8. Strongylus gigas, Diesing.
9. Sclerostoma duodenale, Von Siebold.
10. Oxyuris vermicularis, Bremser.

?11. Spiroptera hominis, Rudolph.
?12. Dactylius aculeatus, Curling.

In this long list, however, not more than three or four demand any notice here, the remainder being for the most part exclusively intestinal parasites. We shall notice only

1. Trichina spiralis.
2. Filaria medinensis.
3. „ lentis.
4. Oxyuris vermicularis.

(1.) *Trichina spiralis.*—Although, strictly speaking, this worm is scarcely likely to become the object of surgical treatment, yet as it may not unfrequently come under the surgeon's notice in the course of operations, and appears also occasionally to be productive of local symptoms, or to require exploration by surgical means for its detection, it may not be wholly out of place to take some notice of it. This curious parasite was first noticed by Mr. Hilton in 1832; and about the same time other cases were observed by Mr. Wormald and Mr. Paget. Portions of the affected muscles having been sent to Prof. Owen, the principal characters of the entozoon were made known by him. Numerous cases have since been published both in this country and abroad, and the subject has attracted the attention of many observers. Küchenmeister supposed that it might be the young state of *Trichocephalus dispar*, and we were ourselves at one time disposed to adopt this view; but later researches have fully shown that the two are perfectly distinct.

The entozoon may be regarded as peculiar to the voluntary muscular system. The muscles affected with it are seen on section, or even without, to be studded with innumerable minute yellowish-white specks of an elliptical form, the long diameter corresponding with the direction of the fibres. Each of these specks on examination will be found to contain a minute vesicle, in which is a coiled-up vermicule about one millimètre in length when stretched out. The cysts themselves vary somewhat in size, and are about one-third of a millimètre long. The cyst appears to belong to the worm itself, and not to be the product of any exudation in the surrounding tissue. *Trichinæ*, however, may exist in the unencysted condition in the flesh of animals without being visible to the naked eye, and even the cysts, before cretification has commenced, may easily escape detection without the aid of a lens.

It has been pretty satisfactorily proved that the chief source of the introduction of *Trichinæ* into the human system is the eating of trichinous pork, and more particularly so if the meat is raw or badly cooked. Even if in the form of sausages or hams—unless these have been long made and well smoked—the flesh of the pig when trichinised appears to be capable of communicating the germs. The vermicules are exceedingly tenacious of life, and retain their vitality even in decomposed meat, and after long immersion in water, or even in glycerine; and the cysts are so constituted as to be unaffected by moderately strong acids.

One of the most remarkable features of *Trichinæ* is the rapidity of their development. A very few days after the ingestion of trichinised meat the vermicules exhibit sexual distinction and maturity, rapidly produce their ova, from which while still within the parent the embryos are liberated, and commence active migration on their own account. This they effect by perforating the walls of the intestine and making their way to the voluntary muscles, where they become encysted, and thus complete the cycle of their existence. The whole process is apparently concluded within a single month, or even less. The genesis and migrations of *Trichinæ* are therefore astonishingly rapid, and it is no wonder that the sudden invasion of such a host of foes should occasionally give rise to grave disturbance in the system.

The invasion is often attended with a singular febrile affection presenting most of the characters of acute rheumatic fever, from which it is mainly distinguished by the absence of any articular affection. Local swellings of the muscles, especially of the calves of the legs, have been observed; and in doubtful cases an exploratory puncture and the abstraction of a minute portion of the muscle have been employed to settle the diagnosis.

(2.) *Filaria medinensis.*—The well-known Dracunculus, or guinea-worm, is perhaps the most important, in a surgical point of view at any rate, of all the human entozoa. Although the greater part of the world is, happily, exempt, except occasionally, from its attack, in those regions in which it is endemic the guinea-worm may justly be regarded as one of the most pernicious pests to which mankind is exposed. Fortunately it appears, strictly speaking, to be indigenous in only a comparatively limited portion of the north tropical and subtropical zones; its geographical centre of diffusion being the continent of Africa south of the Great Desert, and north, as it would seem, of the equator. From this centre, however, it spreads more or less extensively into the contiguous parts of Africa, and to the opposite portion of Asia, extending as far north as the borders of the Caspian and into Central Asia, though how far to the east is uncertain. It is common in many parts of the Indian Peninsula, but more especially towards the west. The abundance of its occurrence in countries beyond the continent of Africa would seem, in fact, to bear some proportion to the amount of their direct communication with the Negro races. For the same reason it has become established in some of the West-India Islands, and especially, it is said, in the island of Curaçoa; and also on the continent in Demerara, and other parts of the mainland of tropical America. But although a certain geographical range may thus be assigned to *Filaria medinensis*, it is nevertheless met with occasionally in all parts of the globe, and in individuals of every race; the only condition apparently necessary being that they should have visited some of the parts comprised in its endemic range within a certain period. It is consequently not unfrequently brought under the notice of the surgeon in this country and elsewhere; and as the effects produced by it are sometimes very grave, the subject of the guinea-worm is one of some importance to him.

Not to enter at too great length into the natural history of the worm, it may suffice to remark that from what is known of it there is every reason to conclude that the parasitic condition represents but one phase of an existence, some portion of which must be passed external to the human or any animal body. This circumstance leads to the consideration of the relations of the guinea-worm to other allied forms. Here we are at once struck with the close resemblance in many respects between its habits and those of several species of *Gordiacea*, or hair-worms, which at one period of their existence are found in the interior of insects or other animals, or even of grain. Several species of *Gordius*, *Mermis*, &c., are known, whose ova are deposited in water or moist earth; the embryos produced from which make their way into the bodies of aquatic or other insects, or of water-fowl, and there become developed into worms, often of considerable length. In the case also of the *Anguillula* of wheat, the larva, according to Davaine,* is known to exist for several months in water, and also to be able to endure complete desiccation for even several years without perishing. From these, therefore—and many more similar cases might be cited—we see that there is nothing unusual in the conditions we have presumed to obtain in that of the guinea-worm.

One important conclusion, in a practical point of view, to be drawn from this observation, is, that the guinea-worm cannot propagate itself directly in the tissues of its 'host.' *It is absolutely necessary for its multiplication that it should pass through some stage of existence external to the body.* And as this stage of existence may be supposed to demand conditions met with only in certain regions, but with which we are not at present fully acquainted, an apparent reason is thence afforded for its limited geographical range.

Some have supposed that there may be more than one species of guinea-worm, and Dr. M'Clelland † even thinks there may be many kinds in India alone. But at present, in our opinion, none of the reasons adduced in support of this notion are sufficient to sustain it.

In its parasitic stage the guinea-worm, when it has arrived at maturity—that is to say, when it contains active embryos of the full size—varies in length from about two feet, or less, to six feet, or even more, if we are to believe some accounts. It appears to be usually shorter, or to arrive sooner at maturity perhaps, in Bombay than is observed in this country in the case of worms contracted on the coast of Africa. In the former locality the length appears to be about three feet; whilst from the latter, so far as our own observation extends, it is seldom less than six. It is cylindrical in form, and nearly white when quite fresh. The surface is smooth, although under a magnifying-glass it is seen to be marked with fine irregular circular rugæ. It is very tough and elastic, to which property, perhaps, more than to any muscular contraction, is due the retraction of the worm when suddenly broken off. In structure it may briefly be described as an elongated tube, open at one end only, and whose walls are constituted by an external integument, strengthened by four longitudinal muscular bands; whilst the interior is lined by the enormously dilated uterus, whose wall is scarcely distinguishable from the common parietes; between the two, however, runs a slender and inconspicuous intestinal tube. The mouth is a simple minute circular pore; and there is no anus. The internal cavity consequently represents the interior of what, were the animal sexual, would be the uterus. As it is, it is more properly comparable with the 'redia' of a trematode, seeing that it produces, by a sort of gemmation, as it would seem, innumerable embryos, which are usually found in an active state in the midst of a grumous or pultaceous substance, and in all stages of development. The full-sized young are about the forty-second part of an inch in length, fusiform in shape, and tapering off rather suddenly into a slender elongated caudal portion. Internally they present traces of an intestine, which terminates, according to some, in an anus at about the junction of the middle and hinder thirds. Vestiges of other organs may also be discerned, to which it is needless here to refer. These minute creatures, when first extracted from the maternal body, are very active and vivacious when placed in warm water; they are also extremely tenacious of life, being capable, as shown by experiment, not only of living for many days in damp earth, but of enduring complete desiccation for a considerable time. The mouth of the young filariæ is merely a simple pore, and they have apparently no organs fitted for boring into animal tissues. The great similarity between these young guinea-worms and certain microscopic filaridæ, and especially one species among them named by Dr. H. Carter *Urolabes palustris*,* has induced that excellent observer to consider it highly probable that they are identical. The species in question abounds in the mud of tanks and ponds about Bombay; and Dr. Carter relates many circumstances in support of his belief, that it is by the entrance through the integument of these minute Filaridæ that the guinea-worm effects its lodgment in the body. He further thinks that the young *Filariæ* enter through a sudoriferous duct, or a hair-follicle. Observation, however, has yet to show the true relation between these unarmed aquatic Filaridæ and the entozoon. In our view of the case probability would seem to be in favour of the notion that the Filaridæ in question do not themselves represent the future parasite; but that the active embryos of the latter, finding their way into the water or mud, develop sexual organs and produce ova, the embryos proceeding from which may or may not have a filariform aspect, and may or may not be furnished with some boring apparatus, but which, as in the case of *Mermis* and *Gordius*, enter the human body and become the guinea-worm, which would thus correspond to a 'nurse' or 'redia,' as before remarked, and as was suggested by ourselves in 1845.† The male guinea-worm is at present quite unknown, and it will probably be found under a distinct guise from that of the female. It may be, and probably is, infinitely more minute than its mate, upon which it may even be parasitic, as in the remarkable case of the gordiaceous entozoon of the humble-bee, *Sphærularia bombi*, described by Sir J. Lubbock.‡

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* Recherches sur l'Anguillule du Blé niellé, in *Mém d. l. Soc. Biol.* 1856.

† *Calcutta Journal of Nat. History*, vol. i. 1841.

The above brief account of the natural history of the guinea-worm will serve merely to give an idea of the direction in which prophylactic measures are likely to be successful. Whether Dr. Carter's supposition be exactly correct or not, it is abundantly proved that the infection of guinea-worm is conveyed directly from without, through the integuments in the neighbourhood of the parts in which it is found lodged. The notion entertained by some that it may be introduced through drinking water seems to us to be devoid of all evidence or probablity in its support.

Symptoms and effects of Guinea-worm.—The entrance of the worm into the body, however effected, is unattended with any observable symptom; and even when fairly lodged and growing rapidly in the tissues, the person affected is wholly unconscious of its existence until the period when it is ready to make its exit, or rather to discharge the cargo of embryos with which it is crammed.

The life of the worm as a parasite may consequently be divided into two periods, in one of which it is latent, and in the other manifests its presence by external signs.

The latent period would seem to vary considerably in duration, if we can rely upon all the reported cases; but in our own experience, which has been considerable, of cases as they occur in the country, the period is from ten to eighteen months, seldom less or more, and usually about twelve. During this period the worm resides in the cellular tissue, and probably in most cases at some depth from the surface; but this of course will vary according to the part invaded. In one case in which a guinea-worm fully six feet long was accidentally discovered lodged in the deep cellular tissue of the leg around the tendo Achillis, and which occurred under our own observation, no morbid symptom whatever was exhibited during life, nor after death was there the slightest appearance of irritation in the surrounding tissue.

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* *Annals and Mag. Nat. Hist.* 1859, vol. iv. p. 32.

† *Microscopical Transact.* vol. ii. p. 80.

‡ *Linn. Transact.* vol. xxiv. p. 101, pl. 21, 22.

When arrived at maturity, the worm makes its presence and the place of its intended appearance known by various symptoms, such as itching and slight swelling, usually circumscribed, but sometimes diffuse, and which gradually assumes the aspect of an inflamed pustule or boil. These symptoms are, in some cases, attended with considerable constitutional disturbance, and with severe lancinating deep-seated pains; but this is by no means always the case. When left to itself, the worm invariably presents itself head first. On this account, unless an opportunity (which rarely occurs) be afforded of seeing the case before the pustule is opened, the head is usually destroyed. The after progress of the case depends very much upon, 1st, the general state of health or habit of the individual; and 2ndly, on the mode in which the extraction is conducted. The latter proceeding is usually effected by winding the protruded portion of the worm round a piece of wood, quill, or bougie, day by day, so long each time as it yields to gentle traction. The animal is tolerably tough and highly elastic, as before said, and will consequently bear a considerable amount of stretching without risk; but, for the same reason, should the force employed be too great, the worm when broken is immediately withdrawn to a great depth. This event is usually followed by considerable deep-seated inflammation and suppuration, which is liable to be succeeded by extensive sinuses and sloughing of the cellular tissue, sometimes requiring long and deep incisions. In these cases there is reason to believe that the remainder of the worm has perished, and that the wide-spreading irritation is due to its presence as a dead and decomposing foreign body. In other cases, however, when the worm retracts in the same way, but in which it does not so perish, the original orifice may close up with little or no signs of irritation of the deeper tissues, and after a time the entozoon will show itself at another distant part of the surface in the same way as at first. In India it would seem that the more experienced native practitioners are skilful in cutting down upon the worm when near the surface, and are thus enabled to seize it by the middle, and to effect its extraction very speedily. It sometimes happens also that the entire worm may be coiled up close to the point of exit, and may thus be removed *en bloc*; but it is far more usual to find that the extraction is a long and tedious proceeding, demanding great care on the part of the surgeon, and considerable patience and fortitude on that of the patient.

(3.) *Filaria lentis.*—Cases are recited of the occurrence of minute filariform worms in the orbit and within the eyeball itself. Some of these, and especially those in the former situation, may not improbably be instances of immature guinea-worms; whilst those met with in the interior of the globe would seem to belong to a different species altogether. Very few cases, however, of this kind are recorded. In three of these the minute *Filaria* was seated in the crystalline lens, or rather perhaps between the lens and its capsule; and in one its habitation was the anterior chamber. To this minute worm, about whose structure and natural history we have no further information, the name of *Filaria lentis*, or *oculi*, has been applied. It may perhaps turn out to belong to the genus *Trichina*.

(4.) *Oxyuris vermicularis.*—The common thread-worm, though properly an inhabitant of the lower bowel only, may occasionally come under the cognisance of the surgeon when it has found its way into the female vagina, or wandered into loose mucous folds external to the anus, where, as in a case mentioned by Cruveilhier, and cited by M. Davaine,* it may give rise to considerable annoyance. Another circumstance also connected with the presence of thread-worms is the sympathetic irritation sometimes said to be produced by them upon the sexual organs, leading, according to Lallemand,* to frequent seminal emissions and other evil consequences.

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* Op. cit. p. 211.

(5.) *Doubtful and false nematoid entozoa.*—Among these may be enumerated

a. Strongylus gigas.
b. Spiroptera hominis.
c. Dactylius aculeatus.

(*a.*) *Strongylus gigas.*—In the kidney and urinary passages of several animals, both carnivorous and herbivorous, but more especially the former, such as the dog, wolf, jackal, polecat, ox, horse, and otter, and more rarely in the abdominal cavity, a large-sized nematoid worm, distinguished by certain characters from *Ascaris* and *Oxyuris*, has been often observed. In dogs it is known to produce various symptoms of urinary disorder. Several cases of a nematoid worm in the same situations in man are recorded by authors; but these accounts are all either of such remote date, or so imperfect, that it is impossible from them to conclude whether the worm in question be really identical with that of the animals above mentioned, or another species of the same genus, or whether, as is not improbable, in all the human cases some confusion has not arisen with the common round worm, *Ascaris lumbricoides.*

(*b.*) *Spiroptera hominis.*—The only case of the occurrence of this supposed entozoon is that related by Sir W. Lawrence † of a woman in St. Sepulchre's Workhouse, who was said to pass worms from the urethra; and they were occasionally even drawn off through the catheter, so that no doubt as to any deception was at the time entertained.

Recent examination, however, by Dr. Schneider ‡ of the specimens which had been forwarded to Rudolphi, and are still preserved in his collection at Berlin, has shown that the grossest deception must have been practised by the patient. The objects were contained in three bottles. In the first they turned out to be specimens of common *Filaria* (*Agamonema*) *piscium*; in the second, which contained what Rudolphi terms 'concrementa lymphatica,' they were apparently fine shreds of some intestine; and in the third bottle were the ova of some fish. It was the latter that were said to have been brought away through the catheter. *Spiroptera hominis*, therefore, should be removed from the list of entozoa.

(*c.*) *Dactylius aculeatus.*—The vermiform creature described under this name by Mr. Curling,§ as having been passed in the urine of a female child of five years old, from the figure and description obviously belongs to the chætopodous worms, and has no claim whatever to be ranked among the entozoic nematoids.

III. *Arachnida.*—The only forms belonging to the arachnida that can properly be regarded as human parasites, although many others may occasionally attack the human subject, are,

1. Acarus (Demodex) folliculorum.
2. Sarcoptes (Acarus) scabiei.

Both of these, however, are more properly to be considered under cutaneous diseases or eruptions, and will therefore be passed over in this place.

IV. *Insecta.*—The same, with one exception, may be said of the parasitic insecta, of which we will content ourselves with giving a list only:

1. Pediculis capitis.
2. „ vestimenti.
3. Phthirius pubis.
4. Pulex irritans.
5. „ penetrans.

We shall concern ourselves here only with the last.

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* *Des Pertes séminales involontaires*, t. iii.

† *Med.-Chir. Transact.* vol. ii. p. 385.

‡ Müller's *Archiv*, 1862, p. 275.

§ *Med.-Chir. Trans.* vol. xxii. pp. 274 and 282.

Pulex penetrans, the Sand-flea (chigoe, chigger, or jigger), is considerably smaller than the common flea, and has a proboscis as long as the body. The male, and also the female until impregnated, lives solely in sand, and does not attack man; but the impregnated female is one of the worst pests in the West Indies, and in many parts of South America. Humboldt states that it only attacks Europeans, and not the aborigines; but there is no doubt it is as much attracted by the Negro as by the white man. The impregnated female introduces itself beneath the nails or between the toes and other parts of the naked foot, and soon enlarges into a white globular vesicle about the size of a pea, by the rapid growth of the ova or rather larvæ, which are formed and contained in a membranous bag beneath the abdomen. The presence of this rapidly growing intruder causes considerable irritation and annoyance, and if the distended orifice be incautiously ruptured, the escape of the numerous progeny into the surrounding tissues is often followed by suppuration and tedious ulceration. The treatment, which requires some skill and sharp eyesight, consists in dilating the orifice through which the insect has entered with a needle, and carefully extracting it whole.

B. Vegetable Parasites.

A considerable number of vegetable parasitic growths have been enumerated as infesting man as well as many other animals, and affecting both the external surface of the body and some of the internal mucous passages which are exposed to the air. These growths belong, for the most part, to the hyphomycetous fungi, and, with perhaps one or two exceptions, amongst which the fungus peculiar to *favus* should, in our opinion, undoubtedly be included, they are in all probability, merely different forms of the common mould (*Penicillium glaucum*), or of other minute fungi of a common kind. At any rate, as they all, or nearly all, are closely connected with certain cutaneous affections which have been treated of elsewhere, it will be needless here to say anything concerning them. It is far otherwise, however, with a particular form of fungus, which appears to constitute the essence of a very serious surgical disease in the East.

In the *Transactions of the Medical and Physical Society of Bombay*, No. VI. for 1861, p. 104, will be found an elaborate paper by Dr. H. Vandyke Carter, concerning a 'New and striking form of Fungus-Disease principally affecting the foot, and prevailing endemically in many parts of India.'

Though the true nature of this extraordinary affection is for the first time explained in this valuable paper, the affection itself appears to have long been noticed by Indian surgeons as one of a peculiar kind. It was distinguished in the medical reports under the name of 'ulcus grave' 'morbus tuberculosus pedis,' 'Madura-foot,' 'peculiar tubercular disease,' &c. The disease appears to be of not unfrequent occurrence in the Bombay and Madras presidencies, and since its nature has been made known cases of it have been met with also in Bengal. It appears, therefore, to pervade most of the hotter parts of the Indian Peninsula. It attacks men far oftener than women, and is almost exclusively confined to the feet.

Dr. Carter distinguishes at least two varieties of the affection; and the account he gives of a case* will serve very well to afford an idea of the appearances produced by it. The subject was a Hindoo farmer, aged about thirty-five years, residing near Poona, in the Deccan. When admitted into hospital on September 21, 1859, his right foot was much enlarged, particularly about the ankle; the general form of the swelling was oval, somewhat resembling that of extensive scrofulous caries of the part; the skin was thrown into coarse corrugated wrinkles. On either side of the ankle-joint and on the dorsum of the foot, near the toes, and also in the sole, were numerous small soft swellings or tubercles as large as a pea or marble, having puckered apertures or fistulous openings; and at these points the skin appeared lighter in colour than elsewhere. The tubercles were in all stages, from a slight elevation of the surface to an acuminated point, and there a puckered fistulous orifice appeared. A probe introduced into one of these openings entered a long but not tortuous sinus, many of which led to bare bone. A discoloured glairy sero-purulent fluid exuded on pressure, frequently mixed with a few black gritty particles. The toes were distorted and displaced upwards, and the muscles of the calf were atrophied. The disease was of twelve years' standing, and the history given was this: when wading in a nullah, or water-course, a thorn stuck in the sole of the foot, bleeding followed, and an abscess formed the size of a walnut. The swelling began to spread, without much pain, from the sole of the foot and toes towards the ankle. Amputation was performed, and the patient made a complete recovery.

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* Loc. cit. p. 111.

On section of the parts after removal, the disease was at once seen to be characterised by the presence of numerous black masses, studded throughout both hard and soft parts. There was no deposit in the cancelli of the bones, and no blending of the parts, as observed in cancer; and the black masses could be picked out quite clean from the cavity or space in which they were contained, and which was lined with a membrane. There was no appearance of caries, the osseous tissue having been removed apparently only by absorption. Nor was there any alteration or thickening of the soft parts, such as occurs in elephantiasis, &c.

In the second variety, although the external appearances are not unlike, a considerable difference exists in the absence of the black masses. The bones are affected nevertheless in a similar way, and a fungus is also to be found. In a case recorded* of this variety, the 'diseased parts consisted of collections of what looked like sloughing tissue; gray or blackish masses, almost glairy in consistence and accumulated in loculi, from which they could be readily drawn out, whether in the soft parts or in the bones, which were ex-excavated to receive them. No black granules were seen, and only after a careful examination were white granules detected in the interior of the loculi.'

The discharge from the sinuses was examined, prior to the amputation, by the microscope: it presented, together with blood-corpuscles and granule-cells, numerous small bodies barely visible as white dots to the naked eye; but when magnified, appearing rounded and tuberculated, of a yellowish tint, and slightly varying in size. These were the fungi.

In some cases, where the disease is still more advanced, the destruction and obliteration of parts is still greater; till at last scarcely any remains of the original tissues either hard or soft are recognisable. The general characters of the affection are thus summed up by Dr. Carter:

1. *External appearances.*—Globular, or flattened form of swelling, often very considerable; never extending above the foot. Skin first studded with blebs or soft tubercles marked with numerous sinuous apertures. A thin discharge, often scanty and watery, and generally containing small granules or particles, either barely visible or distinct, soft, and like poppy-seeds, or black in colour.

2. *Appearances on dissection.*—General confusion of parts, owing to absorption of the bones, and fibrous thickening of the soft parts. Often the presence of granules, separated or aggregated into mulberry-like masses of a yellow or brown colour, lodged in spherical cavities excavated in the bones or soft parts, or in tunnels or channels leading from the cavities to the openings on the surface, and also lined with a membrane.

Sometimes there is a deposit of a fleshy substance, containing numerous minute particles (white or red), and occupying the same localities as the above-mentioned granular deposit. Lastly, in the same cavities and tunnels may be found black granules, spheroidal tuberculated masses of the same colour, and radiated in structure.

Dr. Carter adduces many considerations to show that this curious parasitic fungus is introduced from without, and draws a close comparison between the mode of its invasion and reproduction with that of the guinea-worm, which is highly interesting, but too long for notice here.

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* Loc. cit. p. 115.

Masses of the truffle-like fungoid tubera having been furnished to Mr. Berkeley, that eminent fungologist has procured from them the mycelium and fructification, and has thus determined the botanical characters and systematic position of the fungus, to which he has given the name of *Chionyphe Carteri.*[*]

Amputation of the affected part appears to be always successful in putting a stop to the extension of the mischief.

G. BUSK.

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[*] *Intellectual Observer*, vol. ii. p. 248.

VENOMOUS INSECTS AND REPTILES.

UNDER this head is included the consideration of wounds inflicted by animals, into which some poisonous or irritating material is introduced. In this country and in many others the subject is one of little importance; but in some, more especially in the warmer regions of the globe, it demands the serious attention of the surgeon. But from the great general similarity, except as regards degree of severity, in the effects produced by wounds of this kind, and as their treatment is to be guided by obvious and simple principles, there is neither room nor need for any extended observations on the medical or surgical aspect of the question. But we have thought that some space might be usefully occupied in pointing out the different classes of animals amongst which venomous species are found, and in indicating those species more especially whose attacks are most to be dreaded.

A. INVERTEBRATA.

Poisoned wounds inflicted by insects and arachnida.—In this section might be enumerated a considerable number of species whose bites or stings are attended with a greater or less degree of irritation and inflammation; but from the trifling nature of the injuries inflicted by most of them, it is unnecessary here to notice any but those whose attacks are attended with what may be termed serious effects.

Considered in this regard, the most formidable of the venomous invertebrate animals belong to the classes arachnida and myriapoda. Under the former are included the scorpion, of whose venomous properties there is no doubt, and several spiders, whose evil reputation rests perhaps upon less certain grounds. The only myriapod that can positively be said to possess any venomous power is a species of scolopendra (*S. morsitans*).

(*a*) *The Scorpion* (*S. europæus*, *S. occitanus*, &c.).—The scorpions (Scorpionidæ) are characterised by their elongated jointed caudiform abdomen, which is armed at its extremity with a hooked claw. This claw, which is perforated and connected at the base with poison-glands, constitutes the *sting*. In the larger species, inhabiting the hotter regions of the globe, the effects of the scorpion's sting in man appear to be very serious, if not in some cases actually fatal; and even in the smaller species found in the south of Europe its effects are very unpleasant, and not altogether unattended with danger to delicate or irritable individuals. The symptoms produced by it very much resemble those produced by the stings of bees and wasps in an aggravated degree: such as acute pain, a general nervous shock attended with numbness, vertigo, occasionally temporary loss of sight, vomiting, &c.; whilst the local symptoms are swelling and other signs of acute inflammation, followed in many cases by suppuration, sloughing, and their consequences.

The remedy which appears to have obtained the greatest repute, and to be recommended by the most trustworthy evidence, is the application of ammonia externally, and its internal administration as a stimulant also; although it is probable that any other diffusible stimulus combined with opiates would be equally, if not more, efficacious. A variety of plants, belonging more especially to the Cruciferæ, have also been supposed to possess useful properties in the treatment of the effects of the scorpion's sting.

(*b*) *Centipedes* (*Scolopendridæ*).—Several species of *Scolopendra* enjoy the reputation of being highly venomous; and there is, perhaps, no doubt that the bite of some of the larger kinds, and especially of *S. morsitans*, a large species inhabiting the hotter regions of the globe, has occasionally been attended with very troublesome and painful consequences. The poison of these creatures is conveyed not by a caudal sting, as in the scorpions, but by somewhat similarly-formed curved fangs connected with the mandibles, which are perforated, and probably communicate with special poison-glands, although the existence of such organs does not appear as yet to have been satisfactorily made out. The bite of the centipede, though described as excessively painful, does not seem to be usually followed by the same severe symptoms as is the sting of the scorpion; and it is not improbable, therefore, that no poison is actually introduced.

(*c*) *Spiders* (*Araneida*).—The bite of several species of spiders is said by various writers to be venomous: but the testimony, speaking generally, upon which this property is attributed to them does not appear to be very conclusive.

Spiders have from time immemorial enjoyed the evil reputation of being highly poisonous when swallowed, and very powerful medicinal properties have even been assigned to their webs. These notions, however—no doubt due to the disgust felt by most persons at the sight of such ugly creatures—are of course totally unfounded; nor, perhaps, with one or two more or less problematical exceptions, does there seem to be any better reason for believing that their bite inflicts more than a simple wound.

One or two species, however, deserve more particular notice.

The first of these, the Tarantula or Tarentula (*Lycosa tarentula*), a large spider belonging to the tribe of citigrade, or running spiders, and which abounds in Southern Europe, and more especially in South Italy, has long acquired an extraordinary, but as it would seem wholly undeserved, infamous reputation. The concurrent testimony of all competent observers has conclusively shown that the extraordinary stories of the affections produced by the bite of the Tarantula, and of the no less extraordinary methods of cure adopted, are the records either of wilful deception or of the strange pranks the imagination may play in the apparent production and removal of morbid symptoms. Direct experiments in various hands show that the bite of this spider is unattended with any ill effect beyond slight local irritation.

Another spider, belonging to an entirely different tribe, but which is also found in the south of Europe, is said to produce a similar train of symptoms to those attributed to the *Tarantula*, and doubtless having the same origin.

A third species (*Aranea* 13-*guttata*) is also reputed to inflict a very dangerous and even fatal bite both upon men and domestic animals in the island of Elba; and in Morocco a spider, there called the *tendaraman*, has had equally formidable venomous powers attributed to it. It is said to be common in the cork-forests; and that its bite is so poisonous that the persons bitten by it survive but a few hours. But we may surely be allowed to doubt all such stories; especially when we learn that the spider always makes towards the head in order to inflict its deadly wound.

(*d*) *Venomous insects.*—A great variety of insects appear to have the power of inflicting wounds attended with a greater or less amount of local irritation. But whether in the majority of these cases any poison is actually introduced into the punctures made by their lancet-like proboscis appears to be by no means certain. It is highly probable that the effect, as is often the case with leech-bites, is due to prolonged mechanical irritation only. It must be confessed, nevertheless, that in other cases the severe pain which attends the bites of very minute creatures can scarcely be accounted for, except on the supposition that they are accompanied with the introduction of some irritating, if not actually venomous material; as of formic acid, for instance, in the case of ants; or perhaps of an acrid salivary secretion in other insects.

In some cases, however, it would seem that certain insects are capable of affording a truly poisonous matter of a septic and diffusive nature, by which, independently even of any local irritation, the whole system may be fatally affected. The most remarkable case of this kind is that of the dipterous fly termed 'tsetse' (*Glossina morsitans*), of whose ravages, or supposed ravages, we have so graphic though unsatisfactory an account in Dr. Livingstone's travels. It is true that this fly is innocuous to man; but nevertheless, its alleged effects upon certain animals are so extraordinary, and it might almost be said so incredible, as fully to deserve some notice in this place. The Tsetse is a harmless-looking insect, very little larger than a house-fly; but its bite is said to be certain death to domestic cattle, the sheep, horse, and dog, whilst it is innoccuous not only to man, but to the goat, antelope, ass and pig, as well as to all wild animals whatever, and even, what is strangest of all, to the calf so long as it is sucking. The symptoms attributed to the bite of the Tsetse do not arise immediaely, but after an interval sometimes of several weeks. They appear to commence with a general disorder, attended with weakness and wasting, running at the nose and eyes, and glandular swellings under the jaw. The animals so affected invariably waste away and perish. The affection is said to be quite different from the 'leg-sickness,' and other murrains, which are so common in South Africa; and to present this striking difference from them, that it is not contagious. A herd of healthy cattle is not infected by animals labouring under the effects of the tsetse-bite. Nor is an animal ever affected in the same way unless it has been into a district of country infested by the fly. These districts are described as being very distinctly defined, although separated from a healthy one sometimes only by a narrow river, or even by an imperceptible boundary. Nothing appears to have been ascertained with respect to the infested tracts of country being inhabited by any peculiar plant or vegetation; but, on the other hand, travellers seem to have convinced themselves that the tsetse-fly is never found except in districts inhabited by the elephant and rhinoceros; and that in proportion as those animals are destroyed, do the ravages of the fly diminish. It is much to be desired, however, that the subject should be further investigated.

Dr. Livingstone also mentions another insect, whose bite produces vomiting and purging in the human subject; but as he enters into no particulars we can merely notice the circumstance as one, if truly reported, of a very remarkable kind.

But although the bites of insects are comparatively so innocuous, it is otherwise with their *stings*. Stinging insects belong chiefly, if not exclusively, to the order hymenoptera, in which the sting, in the sterile females, represents the modified ovipositor. The instrument consists essentially of two exceedingly fine and sharp darts, enclosed in a tubular sheath, at the base of which is placed a special venom-gland or sac, whose contents are injected into the wound made by the usually serrated or barbed darts. The well-known consequences of the sting of the bee, wasp, and hornet are too familiar to require particular notice. Though painful and annoying, these wounds, except in cases of persons attacked by numerous swarms, can rarely be accounted serious, though the effects vary a good deal in different persons, and probably are more severe in warmer climates. When large communities of hymenoptera, however, are disturbed, and the assailant is attacked by great numbers of the angry members, very severe consequences, and even death itself, have often followed; and in one instance at least, the sting of a single insect (*Mutilla coccinea*), a native of the warmer parts of North America, is said to produce loss of sense within five minutes after its infliction, and considerable apparent risk to life for several days afterwards.

Various remedies of a domestic nature are recommended to allay the smart and inflammation attending stings; amongst which vinegar, ammonia, flour, indigo in the form of the 'blue-ball' of washerwomen, oil, spirit, eau-de-Cologne, &c., may be enumerated. Of these, ammonia in the form of sal-volatile or eau de luce is perhaps as good as any.

B. Vertebrata.

Wounds inflicted by venomous snakes.—Of a far more important character than those noticed in the preceding section are the poisoned wounds inflicted by animals belonging to the vertebrate sub-kingdom. Fortunately, as compared with the whole number of vertebrata, these are not very numerous, nor are they very powerful, except in the possession of their lethal weapons; and as they are for the most part slow of movement, and of a sluggish and retiring nature, they are not to man, at least in one sense, of any very great importance. The serious and often fatal nature of their attacks, however, render the subject of the wounds inflicted by them one of considerable interest and moment, especially in countries where the more powerful species are met with.

All the truly venomous vertebrata belong to the order of ophidian reptiles; to some few points with respect to the natural history and organisation of which, bearing upon the main subject of this section, we shall therefore now proceed to refer as briefly as possible.

Characteristics and classification of Venomous Reptiles.—Many systematists have begun their classification of the Ophidia by dividing them into the *innocua*, the *suspecta*, and the *venenosa*. But the exigencies of more recent zoological science demand a more exact classification than is afforded by such an artificial arrangement. Not to enter at any length into the principles upon which various schemes for their classification have been based, it will, for our present purpose—that of diagnosing venomous from non-venomous snakes—be sufficient to remark that the Ophidia are very naturally subdivided into two large groups or sub-orders, clearly distinguished from each other by various particulars in their organisation. In one of these sub-orders all the species of which it is composed are more or less venomous; whilst in the others the majority are innocuous in that respect, though some are truly formidable in other respects.

The former group of true venomous snakes have been termed the *Viperina*, or viperine snakes, of which the rattlesnake and viper are familiar examples; whilst the second have been denominated the *Colubrina*, of which the common harmless ringed snake of this country is a specimen.

It will be useful briefly to state the chief characteristics of each sub-order.

Characters of the Viperina.—As has been remarked, all the members of this sub-order are venomous; any snake therefore exhibiting the following characters may at once be so regarded: the body is comparatively thick and clumsy; the general aspect sombre and lurid; and the usual movements sluggish and dull. The tail or part of the body behind the anus is thick and very short; the head broad, depressed, and triangular, or cordiform, joined to the trunk by a constricted neck, and covered on the summit not with plates or scutes, but with small scales, and having the integument usually loose and wrinkled; the eyes are small, wholly lateral, deeply lodged on the sides of the head, and shaded above by prominent over-hanging supraciliary rugose or tuberculated plates; the pupil is elongated and vertical; the upper lip descends on either side like that of the mastiff, so as to conceal the poison-fangs; the scales, lastly, are in almost every instance distinctly carinate or muricate. By these general external characters a viperine snake may usually readily be distinguished; but closer examination of the internal structure of the head and oral organs will disclose still more decisive characters. The chief points to be remarked here are the shortness and extreme mobility of the maxillary bones, each of which supports a single long-pointed and recurved tooth perforated throughout its entire length by a slender canal, and which is termed the poison-tooth or 'fang.' By a peculiar arrangement of the maxillary bones and muscles, this tooth when not in action can be reclined into a grove in the gum, where it is completely concealed, or it can be suddenly and forcibly erected when the animal is preparing to strike its deadly blow. The rest of the bones connected with the jaws, face, and gullet are in a corresponding manner very loosely articulated, and so disposed as to admit of enormous dilatation of the mouth and entrance into the pharynx. Besides the fangs, the upper jaw contains no teeth, although a series of pointed recurved solid teeth occurs along the palate. In the lower jaw similar teeth are found at the extremity.

The *fang*, as has been said, is traversed by a narrow canal, continuous above with a sort of pouch or *sacculus* surrounding the base of the tooth, into which opens the long curved duct of the *poison-gland.* This organ, which with various modifications may be described as composed of tubular follicles communicating with a common canal, and consequently as quite distinct in structure from an ordinary salivary gland, has a thick aponeurotic wall surrounded by muscular fibres, in most cases apparently connected with the temporal muscle, and which are supposed to act as compressors of the gland and ejaculators of its contents. It is usually placed below and a little behind the orbit; but in one remarkable instance—*Causus rhombeatus*—the poison-gland, which is of enormous size, is situated on the back, extending from the nape through nearly one-sixth of the entire length of the body, lying immediately beneath the integument and superficial to the ribs and their muscles.

The Colubrine Snakes, among which are included the Hydrophidæ or Sea-snakes, differ in several important particulars from the Viperina. In external form they are usually slenderer and more elongated, especially in the caudal region. The head is smaller or narrower in proportion, and in nearly every case continuous, as it were, with the body, and in all the more important members of the sub-order covered on the summit with large scutes or plates, usually nine in number; the scales, except in the Sea-snakes, in which they are tuberculate, are smooth and non-carinate; the eyes are larger in proportion than in the Viperina, and, except in one or two genera, have an orbicular pupil. To these general external characters may be added that their movements are more lively and active, and colours in most cases more brilliant and pleasing. Important differences also exist between the two groups in the structure and connections of the cranial and facial bones, and especially in the dentition, in which their great distinction exists. Among these differences we may briefly notice the greater strength and compactness of articulation of the jaws and other bones connected with them, by which the oral cavity and gullet are rendered far less dilatable than they are in the Viperina; and the greater length and size of the maxillary bones, which are furnished with numerous solid conical fixed teeth.

This great sub-order includes by far the largest number of snakes, varying in size from that of an earth-worm to the gigantic dimensions of the Boa-constrictor and great Pythons. Fortunately, few of these genera of snakes are venomous; but among those which are so, we find some of the most formidable of all. With the exception of the Sea-snakes or Hydrophidæ, all of which are reputed to be highly venomous, and are at once distinguishable by their exclusively marine habitat, vertically flattened form, and fish-like habits, it is not easy to lay down in words any very accurate means of distinguishing the venomous from the non-venomous Colubrina. The former usually have the muzzle larger and blunter than the rest; the trunk more elongated, and the tail shorter, stunted, and conical; the eyes smaller, and in some cases with a vertical opening, although the pupil is always round; the nostrils wide and lateral, &c. But the more important species of this group, or those belonging to the genus *Naja*, are characterised by the faculty they nearly all possess of expanding the sides of the neck when in an excited state, whence they are sometimes distinguished by the appellation of hooded snakes, or Cobras da capella. The essential character, however, by which the venomous are distinguished from the non-venomous Colubrina, is the development in the upper jaw of the former of one or more of the anterior maxillary teeth into poison-fangs. As we have said before, these teeth are always fixed or non-reclinable; and they differ also from the true poison-fangs of the Viperina in not being perforated down the centre by a canal, but are adapted to the purpose of conveying poison into the wound by a groove on their anterior or convex side, which is in connection—much in the same way as the canal in the viperine fang—with a special poison-sac or gland; the chief difference being that the duct is short and straight, instead of long and curved, as in the latter case.*

Nature of the 'venom,' and its effects.—Having thus briefly surveyed the general characteristics of venomous reptiles, we shall proceed to say a few words respecting the nature of the poisonous secretion itself, and to describe the effects which follow its introduction.

The venom of serpents is described, when fresh, as a transparent yellowish or greenish subviscous neutral fluid, very much resembling saliva. In other sensible properties it is said to be insipid, and almost inodorous, and, in fact, to exhibit no obvious character denoting its virulent properties. It is heavier than water, and not very readily miscible with it; the mixture when shaken becoming turbid. According to Prince Lucien Bonaparte, it contains, besides albuminous or mucous and a small amount of fatty matter and the usual salts, a peculiar principle, to which he has given the name of 'echidnine' or 'viperine,' but which appears, in most of its characters, strongly to resemble ptyaline. It is said, however, to possess active poisonous properties, which are retained even after it has been dried for a considerable time, if not exposed to the air. But, however simple in appearance and composition this fluid may be, it undoubtedly possesses the most energetic and remarkable physiological properties.

In the first place, it appears to be quite certain that the poison produces no effect, or scarcely any, beyond a temporary irritation of the passages, when introduced into the stomach; the only exception to this being some instances in which it would seem that pigeons were stupefied for a short time after being made to swallow it; at any rate its introduction in this way never seems to be followed by any very serious consequence. Nor does it produce any deleterious effect beyond, in some cases, a little local irritation, when applied to the surface of the skin, even when it has been slightly abraded. It would also appear, from Fontana's experiments, that it is innocuous when applied to an exposed surface of muscular tissue, to cartilage, the pericranium, periosteum, the dura mater, to the medullary cavity of bones, the cornea, tongue, lips, palate, &c. Applied to exposed nerves, it is equally inert; nor does it apparently affect the irritability of detached muscle. In fact, it may be said that the general result of experiment and observation tends to show that, in order to produce its specific effect, the poison must be introduced directly into the subcutaneous cellular tissue, though even here curious anomalies have been observed; amongst which is the circumstance that direct inoculation with the aid of a cutting instrument is less likely to succeed than when the poison is introduced through the fang itself. This, of course, may be owing to the greater outflow of blood in one case than in the other.

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* Besides the undoubtedly venomous snakes above referred to, there is a large class of ophidians, with grooved or channelled teeth, with respect to whose venomous or non-venomous properties the opinion of naturalists have been, and are still, much divided. In these snakes, which have by some been termed '*suspecta*,' the channelled teeth are situated, not in the front of the upper jaw, as in the truly venomous serpents, but behind. It has been conclusively shown in many cases, and can hardly be doubted in any, that the channelled teeth are in connection, by means of a special duct, with a considerable-sized gland, with regard to whose nature it is that opinions have been chiefly divided. Whilst some eminent observers, as Johannes Müller, Milne-Edwards, and Duvernoy, ascribe to it the structure and functions of a true poison-gland, others, as Schlegel, Andrew Smith, Owen, and more recently A. B. Meyer, describe it as having the structure and presumably the functions of a simple salivary gland. The accounts of travellers, also, respecting the effects of the bite of this class of snakes, are fully confirmatory of its non-poisonous nature in the majority of cases. But quite recently (*Monatsbericht der k.k. Ak. d. Wissenschaft*, Berlin, März 1869), it has been shown by the last-named author, that in at least two species of the most innocent-looking snakes (*Callophis intestinalis*, and *Callophis bivirgatus*) the posterior channelled teeth are connected with enormous true poison-glands, much larger, in fact, than those of *Causus rhombeatus*, and which, strange to say, are lodged, not superficially, as in that species, but within the cavity of the ribs, and in front of the heart, occupying nearly one-quarter of the length of the body. Although extended investigations have as yet failed to show the occurrence of similar organs in any other species of the '*suspecta*' than those above named, it is not improbable that such may exist, and consequently in the case of any unknown snake it will be prudent to adhere to the old maxim of *fronti nulla fides.*

When properly introduced, however, its effects are very rapidly manifested; in fact, in some cases so rapidly, as more to resemble those of prussic-acid than anything else; usually, however, a brief interval elapses before the effects are shown. These may be divided into general and local. The first symptom, in nearly all cases, appears to be a general shock to the nervous system, attended with faintness, tremor, and great depression—sometimes with stupor, loss of sight, vomiting, trismus, and general insensibility; at the same time great and sometimes intense local pain is set up. The limb, if the wound is in one of the extremities, rapidly swells; at first pale, the surface of the swelling soon becomes red and afterwards livid, and covered with phlyctenulæ filled with sanious fluid. In severe cases the swelling continues to spread through the whole limb, till it reaches the trunk or even the entire body, whose surface assumes a jaundiced hue. The symptoms, in fact, very closely resemble those of ordinary phlegmonous erysipelas, or diffuse inflammation of the subcutaneous cellular tissue. The constitutional symptoms, independently of the first shock, are what might be expected to accompany such a local affection, and in intensity are in proportion to its violence.

The gravity of the effects of the bite of a venomous snake appears to be in direct ratio to the comparative sizes of the snake and its victim, and also to the quantity of poisonous secretion, present at the time in the saccular gland. It is also greatly governed by the situation of the wound; one on an extremity, for instance, being far less dangerous than on the face or trunk. It has been remarked also that two or more wounds at distant points are more rapidly effective than when they are inflicted in one spot, owing doubtless to the more rapid diffusion which takes place in the former case.

From a general survey of what is known, it would appear that the poison, in whatever principle it may reside, is one which acts primarily on the nervous system, and also as a septic poison on the tissues with which it is brought in contact; and that in order to produce its effects, it must be directly introduced into the circulation.

In the present state of our knowledge it would be a waste of time to speculate upon the real nature of such poisonous, and, as it would seem, such apparently acrid, properties in a seemingly bland and harmless secretion. Its local effects might be regarded as due to its acting as a septic ferment, analogous to that by which many kinds of blood-poisoning are brought about; but if so, the 'venom' would seem to differ from all such ferments with which we are acquainted in the circumstance that its effects vary in intensity directly with its quantity. The minutest possible portion of the variolous poison, or of the septic agent by which scarlatina and other analogous affections are produced, is as efficacious as a larger quantity; and the same may be said also of the septic poison introduced in a dissection-wound, of which the quantity introduced necessary to produce the same amount of local mischief is infinitely smaller than would be required in the case of the serpent's venom. That the effects of a septic ferment should be proportionate, except in a very remote and almost infinitesimal degree, with its quantity, is apparently contrary to all analogy; and at present, therefore, we are hardly justified in looking upon the venom of snakes simply as such a substance, notwithstanding that it possesses some of the properties incidental to it.

It might perhaps be suggested that the 'venom' may reside in a principle analogous to, though quite different from, *ptyaline*, and, like that principle, capable of exerting a rapid catalytic action upon some of the constituents of the blood, under the innocent guise of an inert substance.

With respect to the treatment of 'envenomed' wounds, and further observations on their nature, all that is necessary will be found under the head 'Poisoned Wounds,' vol. i. p. 676.

G. BUSK.

SURGICAL DIAGNOSIS AND REGIONAL SURGERY.

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Surgical Diagnosis.

DIAGNOSIS is the term used by physicians and surgeons to express the scientific opinion, or theory, which they form of each case presented to them in practice. The art of diagnosis may justly be said to be the main object of the study of medicine; as being the end to which all its theoretical parts converge, and the source from which all its practical rules proceed. The substances comprised in the *materia medica* are indeed innumerable, the varieties of surgical appliances and operations are infinite; and a competent knowledge of them is of course one of the fundamental requisites for a good practitioner. Still it is none the less true that the successful application of every one of those means depends upon a correct diagnosis of the morbid action which it is intended to subdue. Hence, a complete treatise on diagnosis is almost equivalent to a complete treatise on medicine; and to endeavour to write fully on surgical diagnosis in this place would be little less than to re-write the whole of the preceding work. But the student of the foregoing pages will, it is hoped, find there all that is necessary to guide him in the emergencies of practice, as far as a book can assist him. The object of what follows is rather to point out the general principles on which surgical diagnosis is founded, and to endeavour to impress on the student the great importance of a full, and above all a methodical, plan of taking notes of cases. To no part of a surgeon's duties is less attention given than to 'taking cases;' and yet it is of great importance towards acquiring the power of correct diagnosis, a power which is the chief requisite for successful practice. Without in any respect undervaluing the triumphs of operative surgery—in fact, while confessing that the successful performance of a great operation is the highest pleasure which the pursuit of surgery affords—we may yet admit that many men of inferior powers have been bold, handy, and successful operators. But the attainment of great skill in diagnosis requires a combination of natural and acquired gifts, which are not within everyone's reach; an amplitude of information not to be afforded by any single experience, and which therefore can only be got by extensive study of surgical literature; a familiarity with morbid symptoms and appearances, and a readiness in combining and in interpreting them, which book-learning is quite unable to give, and which can be acquired only by long and careful study of disease at the bedside; and finally, and above all. a logical power of mind, which neither study nor experience can confer, but which must be born with its possessor.

In the few pages which are here at my disposal I can only hope to give a short exposition of the most elementary and universal principles of surgical diagnosis, with a few familiar illustrations of each topic, chiefly selected from the foregoing essays. I shall then proceed to illustrate the most important element of surgical diagnosis, viz. the anatomical examination of the diseased part, by some account of the more familiar surgical affections as they appear in the various main regions of the body.

All diagnosis, both medical and surgical, rests on three chief elements, viz. 1st, the history of the patient and of the disease previous to the time of examination; 2nd, the symptoms of the disease at that time—i.e. the functional disturbances which it has produced; 3rd, the physical examination of the diseased part. These elements are common both to medicine and surgery; but while medical diagnosis relies mainly on the two former, and chiefly the second (except in diseases where auscultation plays the chief part), surgical diagnosis, on the contrary, is mainly concerned with the third, and hence its greater ease and greater certainty, since it deals more with matters cognisable by the senses. This, too, explains in some measure the great part which anatomy plays in scientific surgical education.

In order, therefore, to cultivate the art of diagnosis with success, the surgeon must be accustomed to investigate the previous history of the patient and of his disease both fully and accurately; he must then collect together the symptoms, and compare them with those of the various known diseases to which they point; he must be thoroughly conversant with every kind of physical examination, and especially by the sense of touch; nor, after all, will he be a master of diagnosis unless he has sufficient reasoning powers to see all these particulars in their proper relative proportion, and sufficient caution and deliberation to weigh them sedulously against each other. We see mistakes in diagnosis committed daily—there are few of us who have not to look back with mortification on many of our own; but most men's experience will bear out the statement, that the great majority of them have been errors of *haste*, due in great measure to a pernicious habit, which the practice of our public institutions tends to create. There a great number of patients are to be attended to in so short a space of time that it is physically impossible to go through the successive steps mentioned above, of enquiring into the history, the symptoms, and the appearances of each one as he presents himself; and the mind is too fatigued by the constant succession of varying phenomena to be able to follow out the reasoning process which is essential at the end of those successive steps. Hence we acquire the habit of leaping to a conclusion in the diagnosis of our own cases, and of acquiescing in the opinions of our colleagues on theirs, without submitting to the labour of examining them methodically for ourselves. Such a habit is, I am persuaded, one of the worst results of our hospital system, and particularly of the out-patient department of it, through which all the officers of hospitals now pass at the beginning of their career. A man who is compelled to see a hundred patients in a couple of hours (and this is hardly an exaggeration of the pace at which the machine is driven) acquires the habit of judging of the case from the first glance, and judges usually with correctness. No doubt much rapidity and decision is obtained by this practice, and there are cases in surgery where these are the qualities chiefly required; but there are many others in which errors can only be avoided by great patience, and habits of this kind produce a character of mind to which patience is a stranger. Hence it is very desirable for students and young practitioners to practice the investigation of cases, whenever it is possible, upon a methodical plan, and to commit their notes of the cases to writing. This is of course unnecessary in many of the simpler surgical cases, but is almost indispensable in some of the obscurer ones, and is a useful corrective of the hasty practice which I have thought it my duty to reprehend. It would, however, be a grievous mistake to suppose that haste is the only danger to diagnosis; and accordingly, in dwelling on the main considerations relative to each of the three elements of surgical diagnosis, the main sources of error connected with them will also be touched upon.

I. *History*.

The first main source of diagnosis, viz. the history, comprises all the facts relating to the patient's ordinary circumstances, such as age, sex, and occupation, which are likely to throw light on the disease to be diagnosed; the circumstances under which the disease first showed itself, its alleged cause, the particulars of the first departure from health, the date at which the patient first sought medical advice, the nature and effect of the treatment adopted, and the progress of the malady up to the time of examination. These particulars are furnished by the patient himself; but they can in many cases be checked or corroborated by the records which the disease has left on the body, in the shape of the marks of old abscesses, the distortions produced by inflammation of muscles, the atrophy of disuse, the results of old disease of joints, &c.

Let us consider these particulars somewhat more in detail.

Age.—The patient's age is one of the most essential particulars in forming a diagnosis of the affection. That this is so at the extremes of life every one is aware. Thus, for instance, in the affections of the hip-joint. If it be an injury of the hip that is under examination, we know that intra-capsular fracture rarely occurs except at an advanced period of life, and never in youth; that dislocation is very rare in childhood; and that fracture of the cervix femoris within the capsule is a comparatively common effect of slight violence in old people of relaxed fibre. If it be a disease of the hip which is presented to us, we at once consider that in childhood the so-called strumous disease tending to, or depending on, chronic caries of the bones is exceedingly common, while acute abscess is rare; that in middle life the inflammatory affections which are excited by injury become more common; while at a more advanced period the main affection of the hip is that disease which was erroneously supposed to be peculiar to old age—chronic arthritis—the 'malum coxæ senile' of our older authors.

Amongst the numerous instances of the importance of paying attention to the age of the patient in forming the diagnosis, we may refer to the following examples taken from the previous pages of this work. In inflammatory affection of the cheek occurring in childhood, the presence or the imminence of that formidable affection called cancrum oris would be suspected, since this disease rarely occurs after ten or before one year of age (vol. i. p. 159); while in later life, rodent ulcer, lupus, and epithelioma, are the prevailing affections. In the examination of these latter forms of destructive ulceration, it must be an important element in the diagnosis that rodent ulcers generally occur in the later half of life, and lupous in the earlier (vol. i. p. 195).

In affections suspected to be hysterical the period of life is of course of the utmost importance in diagnosis, since, though such affections occur to women at advanced periods of life, they are far more common in youth (vol. i. p. 385).

In injuries, if a distinction is to be drawn between dislocation and separation of the epiphysis, the period at which the latter point of bone is developed, and is joined to the shaft, must be steadily borne in mind (vol. ii. p. 40); and in disease of the bones in childhood the same particular is of very great importance (vol. iii. p. 833).

These are a few of the many examples which might be cited of the importance of paying attention to the age of the patient in forming the diagnosis. But errors may easily be committed if more stress be laid on this particular than it deserves. Thus Sir A. Cooper first taught the now admitted fact that intra-capsular fracture of the femur is an injury peculiar to advanced age; and he very justly dwelt on this fact, and on the indisposition of the fracture to bony union, and consequently the impropriety of treatment directed to promote union by enforced rest in bed and confinement in splints. But in proceeding so far as to teach that nearly all fractures of the neck of the femur in old people are of this class, and therefore insusceptible of union, there is no doubt that he exaggerated the influence of age; since it is now demonstrated that most fractures of the neck of the bone, even at an advanced period of life, are partly extra-capsular (vol. ii. p. 857).

Sex.—The importance of sex in the diagnosis of surgical affections is not limited to those of the genital organs and mamma. Other organs, such as the thyroid body, are notably modified in their affections by the influence of sex (vol. v. p. 289); but besides this, the course and the character of all manner of diseases is different in males and females; and in the latter the strange sensibilities of the uterus lead to a train of symptoms most vaguely indicated by the term 'hysterical;' a term which is the only one we can use, though it frequently conveys a very false impression of fiction or exaggeration in cases where the symptoms are as real as those which depend on organic disease, though they are not dangerous to life. Unless such sexual peculiarities were kept constantly in view, the daily-recurring, and quite innocent, painful affections of the limbs, the chest, the head, &c., would be constant sources of needless anxiety.

Errors in diagnosis, however, proceeding from too readily attributing the diseases of females to hysterical causes, are so very common, that the surgeon must be constantly on his guard against them. This is so ordinary a matter of experience that it is needless to cite many instances. The mistake occurs chiefly in the early stages of deep-seated diseases of the bones; as in the case of a young woman, of hysterical temperament, admitted into St. George's Hospital for deep-seated pain about the pelvis. The disease, which was long treated as hysterical, then revealed its true nature by the formation of abscess; and death from caries of the sacro-iliac articulation ultimately ensued.

Occupation.—The patient's occupation is sometimes, although not very often, a matter of primary importance. Thus in disease of the jaw, the fact of the patient being a worker in phosphorus would go a great way towards the establishment of the diagnosis. In diseases of the bursæ again, the patient being a tailor, a miner, a housemaid, would render the diagnosis more secure in case of a tumour situated over the fibula, the olecranon, the patella. Still more frequently the occupations connected with beer- or spirit-drinking (pot-men, butlers, draymen, &c.), and those very laborious trades in which the habitual drinking of great quantities of beer is regarded as almost a matter of course (navigators, coalwhippers, &c.), furnish a very valuable indication for the diagnosis and prompt treatment of the early symptoms of delirium tremens, so apt to follow injuries in such persons (vol. i. p. 341). In some rarer cases the patient has been exposed to the usual influences of particular trades, though his occupation is different; as in Earle's case of the gardener who contracted soot-cancer on his arm from his habit of carrying a bag of soot to use in his garden.

Social condition.—The married or single condition should be noted both in men and women; and in the latter the number of pregnancies and of children, together with the causes, if known, of abortion. In the case of single persons it is often useful to know whether they are in the habit of illicit intercourse, and if so, whether such intercourse is promiscuous or not; and in all cases it is very desirable to be informed of any attacks of venereal disease, and its sequelæ.

Habits.—This brings us to two still more important matters in the patient's history, viz. his habits and his previous diseases. The previous habits of the patient very often account in a great measure for the symptoms which he presents, being the indirect, even if they are not the direct, exciting cause of his disease. It is hardly necessary to do more than allude to the importance which known habits of prostitution would have on the diagnosis of disease (such as a skin-eruption) suspected to be syphilitic; of drunkenness, on that of restlessness, nervousness, and tendency to delusion; of masturbation, on that of peculiar nervous symptoms.* But besides these extreme and familiar instances, there are many others in which a candid confession on the part of the patient might assist the surgeon's diagnosis most materially.

Closely connected also with the patient's habits of life is the character of his mind and his habit of body, both of which particulars often form important elements in the diagnosis, and materially assist the surgeon in determining on the reality of pain, the exaggeration of accounts of previous disease, &c.

Previous diseases.—The previous diseases must be carefully noted, since they often tend to throw light on the constitutional predisposition, and in the practice of surgery are perhaps of equal importance in accounting for local weakness and predisposition to disease. For an illustration of this we may refer to the diagnosis of cutaneous eruptions, or of affections of the bones, in which the history of a previous syphilitic affection, or of a strumous disease in childhood, will often be a main point in the diagnosis. This head will include of course the constitutional peculiarities which the patient may manifest.

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* See a case by Mr. Hilton, in his Lectures on Rest and Pain, p. 268.

But in these three preceding particulars, perhaps more than all others, great care must be taken not to exalt what is, after all, a mere presumption into an absolute indication. Very many cases are wrongly diagnosed and treated, in consequence of forgetting the obvious truth that every disease occurring in an hysterical woman is not hysterical, nor every affection in a syphilitic patient syphilitic. Strumous children are not insusceptible of acute inflammatory affections, and these are often signally benefited by active treatment. Even in a cancerous patient we may meet with an innocent tumour, as is proved by the frequent occurrence in such persons of fibrous tumours of the uterus.

Hereditary tendencies.—Closely allied to the previous diseases which the patient has himself suffered is the tendency to disease which he has inherited from his parents. In some cases this branch of the investigation is easy. Many families labour under hereditary tendencies to phthisis, cancer, or insanity, which are notorious, and are known to their friends as well as to themselves; but in many cases, and in diseases which are not so open to observation, it is otherwise. The most striking instance is congenital syphilis, in which not only is it extremely difficult to obtain evidence from the person who is really in fault, but also the contagion may even proceed from an innocent person; as, for instance, a perfectly chaste woman who has borne children to a syphilitic husband, and thus has contracted the constitutional disease, may bear syphilitic children to a second (sound) husband; or to take a less extreme case, a healthy wet-nurse may be infected by her nursling and carry the disease into her own family, though both she and her husband may have been perfectly free from any known exposure to syphilis.

Of the great importance in diagnosis of the knowledge of the patient's constitutional tendencies, one of the most striking examples may be drawn from the essay on ULCERS, vol. i., throughout the whole of which this point is strongly dwelt on.

When all these preliminary subjects (which constitute the history of the patient) have been investigated, and duly noted, the examiner arrives at the history of the disease properly so called. This embraces the following main particulars: the alleged cause, the duration and onset of the disease, its course up to the time of examination, the nature and effect of the treatment which has been adopted, and some other miscellaneous circumstances.

The alleged cause.—The knowledge of the cause of a disease is of primary importance for its diagnosis. Often, indeed, it is in itself sufficient to establish the diagnosis, as in the instance above cited of the phosphorus-disease, where the cause is the patient's occupation combined with caries of the teeth. But it is often one of the most difficult circumstances in the whole investigation to decide accurately. There is an almost invincible tendency to ascribe the disease to some accidental injury which the patient may have suffered, especially if that injury have acted only, or mainly, on the part affected; and it is often impossible to say whether this causal connection is real or imaginary. Thus, to take a familiar instance, morbus coxarius in children is almost universally attributed by the mothers of the children to a blow, fall, or sprain, and by their medical attendants to the strumous diathesis. without which it is said that the local violence would have been harmless. Which party is most in the right? It is really very difficult to say; yet the point is very important to the diagnosis. If the disease be due to local violence in a child otherwise healthy, its character may be diagnosed as inflammatory, and local treatment may be expected to cure it; and so in the last resort, provided that so severe a measure be necessary, the excision of the whole of the diseased parts may often be expected to succeed; while if the affection be diagnosed as a constitutional one, the surgeon could hope little from local measures. I have selected this instance in order to afford myself an opportunity to put on record my conviction that the diseased joints of children are too often set down hastily as 'strumous,' when in reality the affection is in no manner connected with the strumous constitutional taint.* It is very well known how frequently disease comes on, even after the lapse of a considerable time, in parts which have been the seat of injury (vol. i. p. 624); but it is extremely difficult to decide whether this is due to a real connection, or is a mere coincidence.† But the difficulty of deciding as to the action of an injury is not unfrequently complicated by the doubt whether the injury has really occurred or no. For instance, how very often young female children are said by their parents to have contracted gonorrhœa from illegal intercourse, and how seldom is anything of the sort proved. If every such story was credited by those who see much of infantile leucorrhœa, they would get into constant trouble and disgrace. (See the essay on SURGICAL DISEASES OF CHILDHOOD.) Besides such sources of deception, which rest upon honest mistakes (for the parents usually believe the disease to be so caused), the occasions for wilful deception are numerous. Many surgical diseases and injuries are caused by illegal or disgraceful acts, which the patient will not disclose, whatever may be the hazard of concealing from the surgeon the cause of his ailment (see the article on APNŒA, p. 881). Instances of such purposed concealment come too often under the notice of every surgeon of experience, not to make them very cautious in receiving their patient's statements as to the alleged causes of disease; and therefore it is hardly necessary to quote instances of errors proceeding from a too ready acceptance of this part of the history. Perhaps one of the most fertile sources of these errors is the diagnosis of affections of the larynx in children, as to the presence or absence of a foreign body (vol. ii. pp. 483, 484).

Still, the cause of the affection plays a great part in surgical diagnosis; in fact, it sometimes forms the basis of our classification of disease. An instance of this is afforded by delirium tremens. There are other conditions of delirium which it is otherwise difficult to distinguish from the 'delirium è potu,' but which occur in persons known to be temperate. Nevertheless it is justly held advisable to classify these apart (that is to say, to diagnose them as independent diseases), and to restrict the term delirium tremens to the delirium of drunkards (vol. i. p. 341). The nature of many diseases was unknown till their exciting cause was discovered—a striking instance of which is afforded by glanders (vol. i. p. 700); in hydrophobia also the knowledge of the cause would materially facilitate the diagnosis of the early stage of the disease (vol. i. p. 687).

Inflammatory and other affections are often found to depend upon causes very far removed at first sight from their visible effects, but connected with them by nervous sympathies, which a knowledge of the anatomy and physiology of the nervous system can alone explain. In such cases the diagnosis is the more important, since on it depends the cure of the effect by the removal of the cause. This subject is illustrated by what is said at vol. i. p. 36, as to local inflammation excited by reflex or direct impressions on the nerves of the part inflamed, and by the instances quoted at vol. i. pp. 151, 152, of the effects of deprivation of nervous power in exposing the part to gangrene.

Duration.—The duration of the disease is another point of the greatest importance in diagnosis, particularly with respect to the malignancy or innocence of tumours, to the inflammatory or chronic nature of diseases, and to a thousand such questions of everyday practice. In the diagnosis of the various forms of tumour in the groin and scrotum, the duration of the complaint up to the time when the tumour attained considerable dimensions is a point of extreme importance. The sudden formation of hernia, the gradual descent of psoas abscess, the slow growth of hydrocele, the rapid formation but slow increase of hæmatocele, the steady and rapid growth of malignant tumour of the testis, the slow increase and frequently the complete suspension in growth of varicocele—are among the points connected with this part of the subject which have been dwelt on in the preceding pages.

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* Mr. Bryant would repudiate the term 'strumous disease' of a joint altogether (*Surg. Dis. of Children*, p. 123). This may be going a little too far; but the term has no doubt been much abused.

† It is well known that Sir B. Brodie's death was caused by malignant disease of the shoulder, and that the same shoulder had been the seat of dislocation some years before; but considering how often shoulders are dislocated, and how rarely any such disease follows, it is very difficult to believe that we have more in this instance than a casual coincidence.

Yet here again errors may easily be made. Thus some innocent tumours grow more rapidly than some cancers do; and in all tumours we must remember that the growth may have attained a large size before it has been noticed. Sometimes the growth of cancer is suspended during even a very considerable time (vol. i. p. 556). Again, in the course of a chronic affection, acute inflammation may occur; and the duration of the disease may be greatly influenced by the patient's time of life.

Course of disease.—The course of the disease, from its onset up to the first visit of the patient, is of great importance, when it can be clearly traced; and so to a still greater degree is its course after the patient has come under treatment. There are not a few diseases of which no skill can enable the surgeon to give a confident diagnosis without a knowledge of their course. Examples of this fact might be drawn from every part of surgery; perhaps one of the best is the mistake which long prevailed with respect to cases of partial displacement of the head of the humerus with adhesion of the remains of the long head of the biceps to the bicipital groove. These cases are now known to be due almost, if not quite, always to chronic rheumatic arthritis, and not to rupture of the long tendon of the biceps from injury; the diagnosis having been established mainly by the course of the disease (vol. iv. p. 97).

Effects of treatment.—When the nature and effect of previous treatment can be accurately ascertained, a great auxiliary to diagnosis is often acquired; in fact, in many cases the diagnosis can hardly be established without some such auxiliary. This is particularly the case in tumours of the testis, in which it is often impossible to tell whether the disease is malignant or simple chronic orchitis until the effect of a mercurial course has been noted (vol. v. p. 144). So in tumours connected with bone. It is often impossible to say whether the swelling be a strumous, syphilitic, or rheumatic node, or a new growth, until the effect of appropriate local and constitutional treatment has been patiently watched. But here especial care must be taken to guard against errors which are very liable to occur if the effect of treatment be judged of from the statements of the patient; so that little importance can be attached to this particular in forming the diagnosis, unless the treatment has been watched by the surgeon himself, or has been noted by another medical observer. Even then the temporary fluctuations occurring in all diseases are a fruitful source of error; as in the instance cited above of a tumour of the testis, in which the diagnosis between cancer and chronic inflammation is to depend on the effects of a mercurial course. In malignant disease, temporary improvement of the patient's condition, and even some apparent diminution of the tumour, often follow on the rest in bed and other measures which are then for the first time adopted; and thus the surgeon is liable to be deceived into the belief that his treatment is acting upon an inflammatory disorder.

II. *Symptoms.*

The second of our general heads is that which comprises the symptoms presented by the patient at the time of examination. These symptoms are either those which the patient describes or those which he exhibits. Here the second of our general heads touches closely on the third; for the examination of the patient's body discloses changes from the healthy condition which are in reality nothing but symptoms. In this place, however, it is intended to describe not the local lesions, but the general alterations from the natural state—the general physiognomy, as it were, of the disease. It is in the application of these general symptoms to the diagnosis of disease that the surgeon has most need of an intimate acquaintance with physiology, since he has to connect all the functional disturbances which he discovers with the appropriate lesions of the organs presiding over those functions, and those again with their possible causes. It is difficult to arrange these symptoms in regular order, as we have done the particulars embraced under the title of 'History.' Unlike what occurs in medicine, almost every surgical disease has its local seat, and the few diseases which affect the whole body, as struma, constitutional syphilis, multiple or constitutional cancer, and erysipelas, are generally obvious. Thus surgical diagnosis, as far as it deals with the symptoms of disease, is chiefly concerned in obtaining a minute knowledge of the signs of each particular local ailment, and in separating them from each other. When the surgeon has thus become accustomed to connect each disease with its own group of symptoms, he has to compare each group in his own mind with the account which the patient has given of his sufferings from the disease under examination. Here the difficulty is twofold. In the first place, as regards the groups of symptoms which we have been taught to associate with the name of each disease. These groups have been laid down in our books, as is done in the previous part of this work, with all the conscientious exactness which the subject demands. But we must remember that the names of diseases frequently do not represent natural objects created different from each other; but are merely designations which have been affixed to sets of symptoms grouped together by nosologists. Now the infinite variety of nature easily eludes the bounds of our formal classification; and we are constantly meeting with groups of symptoms which can only be brought under one of these designations instead of another by a certain amount of violence, and which do in fact partake of the nature of both. Thus, to take an instance lying at the very threshold of our pathology—ulceration and gangrene in soft parts, or their equivalents caries and necrosis in bone, are names given to what are really parts of the same process, viz. the termination of inflammation in local death. The things are easy enough to distinguish from each other in extreme cases. When the bodies of several vertebræ have, as it were, melted away, without any visible portion of dead bone having ever been known to have exfoliated, there can be no hesitation in saying that here we have caries, not necrosis; when a limb drops off from the trunk black and rotten a few days after an injury, that this is gangrene, not ulceration. But in many cases the two processes are mixed; and many receive different names from equally competent observers. Persons not in the medical profession, with whom the names of diseases are naturally held to represent real entities, are of course scandalised at such differences, and believe that they show either ignorance in the persons or imperfection in the art. They really show nothing except that scientific language cannot acquire the copiousness and variety of the natural processes. This difficulty, however, though it may lead to some confusion and some apparent difference of opinion in the intercourse of practitioners with each other, is not otherwise of much practical moment, since the indications of treatment depend less on accuracy in naming the disease than on sagacity in weighing its chief symptoms. The second is the more important of the two difficulties, viz. the difficulty in ascertaining from the patient what the symptoms really are. Patients who have acquired, as so very many have, a superficial knowledge of medical books, can easily describe the leading symptoms of cancer, uterine disease, stone, &c., which they either feel or imagine they feel. Besides, without the exercise of unusual caution it is very difficult for the surgeon to avoid putting leading questions on a hypothesis hastily formed; and such questions are pretty sure to be answered in the way he desires. Thus great caution in weighing the patient's assertions, and comparing them with the indications to be drawn from his general condition and from the local appearances, is required in one who is to be a good investigator of symptoms; and with this should be conjoined much deliberation in forming any guess at the diagnosis before the evidence is complete, and much dexterity so to phrase the questions addressed to the patient as not to suggest to him in what way to answer them.

The least unsatisfactory way of arranging the symptoms appears to be in the order of the various organs whose functions such symptoms show to be disturbed. The table printed below (p. 958) will prove one of the most convenient methods of arrangement; and we shall devote in the sequel a few lines to some illustration of the groups of symptoms which are comprised in each of its headings, and of their practical importance in surgical diagnosis.

Nervous system.—The first class of symptoms are those referred to the nervous system—the brain, spinal cord, and nerves. In our table these several parts of the nervous system have been separated from each other; and it is one of the main objects of the diagnostician to effect this separation; that is to say, to determine what symptoms point to the brain, what to the spinal cord, what to the nerves. To illustrate from one of the most common surgical symptoms, loss of motion following on injury. If the loss of motion affects one side of the body only, and is complicated with loss of consciousness, it is a clear indication of limited pressure on the brain. If no loss of consciousness is observed, it is only after the most searching investigation that we can admit that the loss of motion depends on lesion of the brain; yet if the palsy is strictly limited to one side of the body or to one set of nerves, this is the more likely hypothesis. If it affects both sides of the body, but not the intellect, or the facial muscles, or the functions of the nerves of special senses, the lesion must be in the spinal cord, at a level determined by the origin of the nerves of the highest part to which the palsy extends. And we may observe that the more complete the palsy both of motion and sensation, the more extensive must be the pressure on, or disorganisation of, the cord. If, on the contrary, paralysis of the whole body is present with coma, the lesion must affect the brain, and that to a very great extent. If the loss of motion affects only a small part of the body, as a single limb, or a segment of a limb, or a still smaller part, it is clear that the nervous centres themselves are untouched; the lesion has either implicated one or more of the nerves; or else the loss of motion depends on injury to bones, joints, or muscles. The diagnosis depends in a great measure on whether the extent of the paralysis does or does not coincide with the anatomical distribution of the nerves.

Pain.—In the table already referred to, pain, which is of all symptoms the most universal, has been placed under the head of 'nerves;' but this is only an arrangement dictated by convenience. The sense of pain, though always conveyed by the nerves, yet, as a diagnostic indication, comparatively very seldom points to the nervous system itself, but is usually indicative of a morbid state of the organs from which the nerves are derived. Want of space is alone a sufficient obstacle to our discussing the wide question of the value of pain as a symptom of disease.* Study of any section in the previous part of this work will show that almost every single affection has its peculiar kind and degree of pain. Such a study will also prove how much caution is required in estimating this complex and universal symptom; how easily inflammatory pain may be confounded with neuralgic or hysterical, and *vice versâ.* Again, the affections of many organs are signalised by pain in remote parts; as the pain in the knee, which is symptomatic of disease of the hip; the pain in the meatus urethræ, symptomatic of stone or ulceration of the bladder, or sometimes of disease of the kidneys; and generally the great number of instances in which pain referred to the extremity of a nerve is symptomatic of irritation at a higher part of its course.

Organs of sense.—The symptoms referred to the organs of sense are those defects of sight, taste, smell, hearing, and touch, which are almost always present in all diseases, and which point either to organic lesions, functional disturbances, or affections of the nervous system, as the case may be. It would be endless to enumerate them. Let us take a prominent instance. If the student will turn to the essay on DISEASES OF THE EYE (vol. iii. p. 127), he will find an account of the numerous organic lesions of the deeper parts of the eye upon which loss of sight may depend; but loss of sight, even total loss, may be symptomatic merely of some affection of parts remote from the eye, as abscess of the antrum (vol. iv. p. 358); or may depend on some disease of the brain or the optic nerve (vol. iii. p. 125); or may be merely an effect of hæmorrhage, or of some depressing habit producing anæmia of the choroid or retina (vol. iii. pp. 129, 133). Most of these symptoms are obviously local, and their interpretation depends in a great measure upon the results of a physical examination of the organ.

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* The reader may be referred to Mr. Hilton's Lectures on Rest and Pain.

Organs of respiration.—The symptoms referred to the respiratory organs, though of less vital importance in surgical than in medical diagnosis, are yet numerous and highly important. We must be content here with one or two illustrations of the truth, that the broad facts, at any rate, if not the minutest phenomena, in this group of symptoms must be as present to the mind of the surgeon, if he would succeed in diagnosis, as to that of the physician; and it must not be forgotten that the diagnosis of surgical affections of the respiratory organs involves often that prompt action on which the instant saving or loss of life depends. Thus, in injuries of the neck, the importance of recognising the dyspnœa which may arise from fracture with displacement of the hyoid bone, and distinguishing it from the numerous other causes which may produce the same effect, is well illustrated by the case related at p. 910. Again, in the same class of cases, it is of the utmost importance to have studied minutely the symptoms produced by the impaction of a foreign body; to distinguish, for example, between the usually paroxysmal dyspnœa, with pain about the thyroid cartilage, but without fever or effusion in the air passages, which are the leading symptoms of a foreign body impacted near the glottis, and the dyspnœa of croup (vol. ii. p. 485). It is true that the history, if it could be relied on, would make the diagnosis certain; but frequently in these cases the history is unknown or fallacious. To proceed with the same illustration, the reader may consult (vol. ii. p. 481) what has been said about the diagnosis between pneumonic consolidation causing absence of respiratory murmur, and the same phenomenon as the consequence of impaction of a foreign body in one of the main bronchial tubes. So too of the diagnosis between the various sources and kinds of effusion into the pleura after accident (vol. ii. pp. 589 et sqq.).

Organs of circulation.—The condition of the organs of circulation is of very great importance in surgical diagnosis; not merely the general state of the pulse, which is always noted as a matter of course in all diseases, medical and surgical, but also the irregularities in the organs of local circulation, arterial, venous, and lymphatic. The various alterations in the arterial circulation caused by an aneurism furnish the most familiar example of the diagnostic signs drawn from the arteries; but there are innumerable others; among which we may instance the sudden loss of pulse in the lower part of a limb, traceable up to a definite point, after an injury, without great ecchymosis, diagnostic of rupture of the inner coats of an artery (vol. i. p. 736); the extraordinary enlargement of arteries, naturally imperceptible, which is observed in aneurism by anastomosis (vol. iii. p. 535); and the peculiar thrill noticed in the pulsation of the larger arteries in anæmic persons. In the venous circulation, some of the most common diagnostic phenomena are the passive enlargement of the veins of a part, with or without œdema, which marks simple obstruction at a higher point of the vessel, whether from coagulation of the blood, or pressure of a tumour; the hardness, redness, and tenderness along the vein, with œdema, which characterise phlebitis (vol. iii. p. 371); the purring thrill which is felt in large veins from pressure not completely interrupting the current. In the absorbent system, besides the direct evidences of inflammation (vol. iii. p. 327), and the rare examples of lymphatic fistulæ (vol. iii. p. 328), the chief phenomena to which attention is called in diagnosis are those of simple inflammatory or specific enlargement of the glands.

The errors which may be committed in the interpretation of these symptoms are very numerous. Thus the sudden stoppage of the arterial circulation may be due to embolism and not to accident; the enlarged vessels around a vascular tumour, though they pulsate, may be some of them veins;* the thrill referred to anæmia may be due to aneurism; the venous enlargement and œdema may be due to simple retardation of the circulation without positive obstruction; the glandular enlargement to irritation, and not to morbid deposit.

Digestive systems.—Besides the general indications which are to be drawn from the condition of the tongue and of the bowels, the symptoms which refer to the various portions of the alimentary canal occupy a high place in the diagnosis of many surgical ailments. The importance of studying the general condition in cases of constipation, in order to the diagnosis between mere mechanical obstruction, acute strangulation, inflammation, and simple inaction, will be appreciated by perusing the observations on that subject (vol. iv. pp. 601 et sqq.). Perhaps we ought also to illustrate the fact, that symptoms referable at first sight to the digestive system may be only reflex phenomena excited by disease or injury of remote parts. The familiar instances are the vomiting, which is symptomatic of early disease of the kidneys, and that which almost always follows on superficial injuries of the brain (vol. ii. p. 306).

Urinary organs.—The general symptoms which are referred to the urinary organs are less important in surgery than in medicine. these symptoms being mainly confined to the cases of local disease of the organs, but not entirely so. A perusal of the essay on DISEASES OF THE URINARY ORGANS will show how numerous and complicated are the general phenomena which the surgeon must master in order to the successful diagnosis of the affections of that system. With reference to the bearing of urinary phenomena on the general condition of the patient, the most practical example is the frequent disappointment which operating surgeons experience from having neglected to examine the urine before proceeding to operation, and having accidentally performed a serious but avoidable operation on a patient labouring under Bright's disease. It ought to be a fixed rule never to operate on a case of chronic disease of a joint, to extirpate a large tumour, or perform any other operation which is not absolutely inevitable, without a previous careful examination of the urine.

Genital organs.—The functions of the genital organs are disturbed almost exclusively by local diseases; but in the male sex a few general diseases react on the sexual system; an example of which is the atrophy of the testicles which follows mumps in some rare cases (vol. v. p. 109), and occasionally succeeds injuries of the head (vol. v. p. 161). In the diagnosis also of some affections of the brain, it is important to note the sexual symptoms; an instance of which is furnished by the perverted sexual appetites which are occasionally symptomatic of epilepsy, and are sometimes regarded as its exciting cause (vol. v. p. 155).

Locomotive system.—The locomotive system also furnishes us chiefly with indications comprised under the head of 'Physical Examination,' unless the skin be included under this term. Every symptom connected with this great eliminant organ should be most carefully noted in the first and in all subsequent examinations of the patient. Its heat, dryness, harshness, colour, state of circulation, presence of eruptions, and a host of other particulars too numerous to mention, furnish diagnostic indications of the greatest importance.

Miscellaneous.—Finally, there are some miscellaneous symptoms which cannot be referred to any of the organs of the body, but which may have a considerable influence on the diagnosis of the disease.* Thus the condition of restlessness and malaise which accompanies inflammatory fever (vol. i. p. 21); the cachexia which is so striking in some cases of cancer (vol. i. p. 577); the general physiognomy which is to a certain extent characteristic respectively of hysteria (vol. i. p. 379), of struma (vol. i. p. 363), and of secondary or constitutional syphilis (vol. i. p. 462); the tendency to symmetrical occurrence in certain diseases (e.g. hypertrophy of the bones of the face, vol. i. p. 538), are particulars not to be referred to any distinct system of organs, but which it would be extremely inaccurate to overlook in forming a diagnosis.

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* This has been particularly noted in arterio-venous aneurism, as in Mr. Moore's case, quoted at vol. iii. p. 529; but I have seen the same thing in cirsoid aneurism.

III. *Physical Examination.*

Our third elementary division refers to the physical examination of the diseased parts. As this must of course be done by the surgeon's senses, it is convenient to refer to the main particulars under the head of the special sense by which they are perceived: as those which are discovered by the sight—alterations in form, in colour, in volume, in shape, in transparence, and here we must speak of microscopical and other instrumental observations; by the touch—alterations in consistence, in relation, in volume, in pulsation, in mobility; by the hearing; and by the smell.

To these we ought to add chemical examination, in which all the above senses are employed. This method of examination has superseded the disgusting applications which were made of the sense of taste by the medical practitioners of a former day, so that this sense bears no part in diagnosis.

The microscope.—Let us commence this long list of particulars by the visual phenomena; and first of the artificial aids to vision. There are a great many cases in which the surgeon has to make use of the lens in forming his diagnosis. For persons of not very sharp sight, a convex lens is necessary in examining the eye for minute foreign bodies, colourless hairs, crab-lice, and on other such occasions; and its aid is invaluable in throwing an oblique light into the eye, to examine the capsule of the lens and the contents of the posterior chamber. In skin-diseases also a lens is very frequently serviceable.

The use of the microscope in surgical diagnosis is a matter on which practical men differ extremely. Like most other things, in this age of minute research, the microscope has become a speciality in practice, and is therefore decried by those who know little of its use, and exaggerated in importance by those who know little else. But the truth lies, in all these cases, between the extremes. What was at one time believed to be the special province of the microscope in surgical diagnosis, viz. to distinguish between cancer and innocent tumours, has been found to be a problem beyond the unaided powers of the microscope; and, in fact, as our knowledge of the subject has advanced, the sharp line which was formerly thought to separate malignant and innocent tumours has become less distinct, and it is generally allowed that there are forms of disease which partake of the character of both (vol. i. pp. 548, 553): yet the value of a good microscopical examination of a tumour has been fully established, though it is now considered as, in many cases, only one of numerous diagnostic signs, to be used along with the history, the naked-eye characters, and the relations of the tumour, in forming a judgment as to its nature; and in that connection of very great importance, although not to be trusted to alone in complicated cases. There are numerous simpler cases of tumour in which microscopical examination alone suffices for diagnosis; but in many of these cases the diagnosis can also be formed without its aid. All this refers to tumours after their removal from the body; but in the living body also it is often possible to remove a very small portion of the tumour for microscopical examination; and such a method is occasionally made use of (vol. v. p. 927).

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* A few of these miscellaneous particulars would, in our scheme (pp. 958–960), be referred to under the head of 'Remarks;' the greater number would find a place under the heading 'Aspect.'

It is, however, in the examination of the fluids of the body, and of substances discharged or said to be discharged, that the microscope has its most undoubted and most important use. The pathology of urinary affections rests almost as much upon microscopical indications as upon all other methods of examination put together. The presence of pus-globules, of blood-globules, of epithelium, of spermatozoa, of animalcules, of fungi, and of other microscopical objects too numerous to mention, in matter evacuated naturally or artificially, often materially assists or even alone establishes the diagnosis of a case; while innumerable instances of delusion and trickery, in which foreign substances are alleged to have been passed from the mouth, urethra, vagina, and rectum, can only be distinguished from those which are real by its agency; and in the latter case the microscope alone can establish the diagnosis, and thereby perhaps relieve the patient from the fear of an internal tumour, who may have simply passed a shred of undigested meat from his bowels; or announce to one in whom an intussuscepted portion of intestine has been passed the possibility of recovery of health; or again warn the friends of another in whom organised and apparently malignant structures may be passed from the anus that these are probably the fragments of some hidden tumour in the bowel; or in whom small fragments of fæces may be detected in the urine that these prove the existence of a communication between the bowels and bladder (vol. iv. p. 895).

In skin-diseases again the microscope is indispensable, and has doubtless rendered to that department of pathology the best service which it has received of late, by clearly marking out certain diseases as local, depending on the presence of a parasitic plant or animal, and therefore in all cases curable by simple local measures directed to the destruction of the parasite (vol. v. pp. 335 et sqq).

The above is not meant as an exhaustive enumeration of the uses of the microscope in surgical diagnosis, but merely as a specimen of its chief applications; and it justifies us in saying, that though a man may be a very good surgeon without being anything of a microscopist, yet the highest attainments in diagnosis cannot be within the reach of such a one.

Ophthalmoscope, &c.—Of the diagnostic value of the inventions for examining special organs it is needless to say anything here, since a reference to the essay on DISEASES OF THE EYE will suffice for the ophthalmoscope; to DISEASES OF THE EAR, for the speculum auris and otoscope; and so on. One word may perhaps be added with respect to one of these instruments, the use of which has excited much contention—the speculum vaginæ. Although there can be no doubt that the examination of women, and especially unmarried women, by this means, has been carried to a most unnecessary, indecent, and reprehensible extent, both in this country and elsewhere, its use cannot on that account be dispensed with in appropriate cases. Those which fall under the care of obstetric physicians need not be spoken of here. The main uses of the speculum vaginæ in surgery are to examine the vagina and neck of the uterus for sores, in case of discharge after suspicious intercourse, to examine and expose tumours situated about the os uteri or in the wall of the vagina, and in plastic operations on the vagina.

Alterations in form.—The surgeon ought to be so intimately acquainted with the natural form of every part of the body, that any variation, beyond those natural minute differences which constitute individuality, should arrest his attention at once. Striking instances of the importance of recognising any little alteration in form due to disease may be found in every part of surgery. Thus the slight fulness caused by a strangulated obturator hernia was noticed by Mr. Obré as constituting a difference between the two femoral fossæ, and led him to the happy idea of cutting down upon and liberating the constricted knuckle of intestine (vol. iv. p. 781).

Colour.—The natural colour of parts is composed of the colour of the blood circulating in them, and that of any special pigment they may contain, seen through varying thicknesses of skin or through mucous membrane. Hence variations from the natural hue may be caused by alterations in the mass of blood (pallor and redness), or from detention of blood in the part (lividity and ecchymosis), or from absence or undue deposit of pigment (of the former of which albinism may be taken as an example, of the latter melanosis, the cutaneous maculæ, Addison's disease, vol. v. p. 408), or from undue thickening of the cuticle, or cutification of the mucous membrane (as in prolapsus vaginæ).

Volume.—The alterations in the volume of parts depend either on hypertrophy of their natural elements, or on fluid or air effused into their interstices, or on the organisation of inflammatory products, or on the pressure of a new formation. In distinguishing these various particulars from each other, the touch must often come to the assistance of the sight. The hypertrophy of the skin and cellular tissue which constitutes elephantiasis can indeed be recognised by the unaided sight; but in order to distinguish between the thickening of hypertrophy (so called) of bone, and that of periosteal deposit, the part must be carefully examined with the hand; so of the swelling of œdema or emphysema, of dropsical effusions, of chronic inflammation, and of tumours.

Transparency.—The familiar instance in which transparency is used as the test of the nature of a disease is hydrocele; but in a few other cases it is also employed, as in cysts in the popliteal space, occasionally. Opacity also is a phenomenon which is still more frequently noted by the surgeon, and more especially in the humours of the eye.

Consistence.—Alterations in consistence are, amongst all other tactile indications, those from which diagnosis derives most frequent assistance. It would be endless to enumerate all of them: the softening or hardening of different stages or varieties of inflammation, the flabbiness of atrophy, the rounded softness of fat, the boggy feeling of gangrene—are among the most familiar illustrations. Some among these tactile phenomena, however, deserve special mention, viz. emphysema, crepitus, and fluctuation. The first is the peculiar crackling which denotes the presence of air in the cellular tissue. It is a sensation which is often to be met with, and which, when once known, can hardly afterwards fail to be recognised, since there is nothing else exactly like it. It is a kind of crepitus, but cannot be confounded with that sensation. Its most common cause is the escape of air from the respiratory organs into the cellular tissue; and it becomes a sign of importance in wounds or contusions of the neck and injuries of the chest, proving the existence of a wound of the trachea, a fracture or rupture of the larynx or some lower part of the tube, an injury of the lung in cases of fractured ribs, an opening of the pleura or a wound of the lung in penetrating wounds of the chest. But there are many other causes of emphysema. It occurs, though rarely and only to a limited extent, around punctured wounds in any part of the body, or around the opening of an abscess; it may be caused by a wound of any part of the gastro-intestinal tract,* and is one of the symptoms of the decomposition of the tissues in gangrene.

Crepitus is a name given by surgeons to the crackling produced by the rubbing of two rough surfaces together. When used in a surgical description without any qualifying adjective, it is intended to signify the rough grating which is produced by the friction of two exposed bony surfaces on each other. It is, therefore, pathognomonic of fracture in a case of recent injury, and of erosion of the cartilages and ulceration of the exposed bony surfaces in a case of joint disease. There is no sensation which can be confounded with this kind of crepitus, nor any ambiguity in the indications to be drawn from it. But besides this fresh rough bony crepitus there are other kinds of crepitus, indicating different conditions, and sometimes rather difficult to make out. The effusion which follows inflammation of the sheath of a tendon produces a kind of crepitus which, in its simplest form, is very easy to distinguish from bony crepitus, it being more of a creaking than a crackling, and obviously produced by the rubbing of soft though somewhat rough surfaces together (vol. iii. p. 646). As the lymph which produces the sensation becomes drier and harder, the crepitus becomes rougher, but never attains the crisp decided feeling of the crepitus of a recent fracture. But the crepitus of a fracture becomes less crisp and decided as the bony ends get rounded off and coated with soft matter. Hence in injuries which are not recent, it is often difficult, and sometimes impossible, to decide whether the crepitus is from effusion in sheaths of tendons or in joints, or whether it is from fracture. This is particularly the case in the examination of injuries of the shoulder-joint some time after their infliction.

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* After a wound of the rectum made in puncture of the bladder per rectum, I have seen emphysema occur and extend up to the chest; so that the feeling of the parietes of the thorax was just what is perceived in cases of fractured ribs.

Again, crepitus is produced in old rheumatic disease of the joints; but it is usually easy to distinguish this from the crepitus of caries; for this crepitus, being due to the rubbing of the 'additamentary' pieces of bone on each other, is far freer and more decided, and is obviously caused by portions of bone far more movable than the carious surfaces of a joint can be. I have seen a case in which the sound produced was so loud that it could be distinctly heard at some distance (vol. iv. p. 27).

The most important of all the diagnostic signs dependent on the touch is *fluctuation*, or the sensation of fluid enclosed in a cavity. This sensation depends on the well-known properties of a fluid, viz. that its particles are movable on each other by the slightest possible force, or, in other words, that a fluid has no cohesion, and that it is incompressible. The most perfect example of this sensation is where thin serum is enclosed in a moderately tense bag, as in the case of a large ascites. In such a case, if a finger be firmly laid upon any part of the bag, the least tap given to any other part of the bag with the fingers of the other hand will cause a distinct wave of fluid to strike the first finger. This is the most usual way of ascertaining fluctuation, and the most certain; but of course it is not available for limited and deep-seated collections. Smaller collections are more usually tested in this manner: alternate pressure is made with the fingers of the two hands; when one finger is pressed down gradually and firmly on the collection of fluid, the latter, being incompressible, transmits the pressure, however slight it may have been, to the other finger; and the sensation of a rounded elastic body is communicated to that finger. This sensation is usually verified by repeating the proceeding with the two hands alternately. Care must be taken not to forget that the elastic reaction of the fluid is perceived, not by the finger which is making active pressure on the tumour, but by that which is lying still on its surface, and therefore to direct the attention to that finger. The perfection of the sensation depends on the fluid being enclosed in a capsule, and on its not being too deep-seated. When the quantity of fluid is small and deep, another method is often used. This consists in pressing the end of the finger sharply down upon the supposed fluid and suddenly withdrawing it a little, when the wave of fluid which was driven down by the push of the finger will rise up and strike against it.

It is in his accurate perception of fluctuation that the surgeon chiefly shows his tactile accomplishment. But there are many cases in which it is very difficult to decide upon the presence of fluctuation, and many in which it is impossible. Nor need this appear strange if the cause of the sensation be considered. It depends mainly on the fact that the particles of a fluid are movable on each other by the slightest possible force; that it has no cohesion. But this, though true of the pure fluid with which physical reasoning is conversant, as the pure serum in the above instance, is by no means true of the mixed substances sometimes found in the body, of which it is difficult to say whether they are more fluid or solid, and which are very soft and very elastic, but still can hardly be said to have no cohesion or to be incompressible. Thus in some very soft tumours, almost of creamy consistence, such as the most rapidly-growing of the cancerous tumours of the liver, it is impossible, even after they have been removed from the body, to say whether they fluctuate or no; and in the soft mass of granulations into which the synovial membrane of the knee is converted in the gelatiniform degeneration, it is hardly possible to say whether the soft mass does or does not contain one of those limited collections of fluid, so often found there, without the use of the grooved needle.

The latter instrument should always be used in such cases, and will clear up any doubt which the surgeon may feel.

Fluctuation may also be prevented by the thickness of the sac in which the fluid is contained, as in some old hydroceles; or by the extreme tension of the sac preventing the slight displacements which are essential to the undulation of the fluid. This, also, is often noticed in hydrocele. The extreme depth of the collection, again, and the mass of soft parts covering it, may so obscure the sensation as to prevent any confident diagnosis. In order, therefore, to avoid errors as far as possible, and to avoid the appearance of error in circumstances where an accurate diagnosis may be unattainable, the surgeon must be very careful to familiarise himself with the numerous circumstances in which fluid may be present without fluctuation being felt, and, on the other hand, where a deceptive sensation of fluctuation may be elicited from soft and elastic solids.

Relation.—Changes in the natural relations of parts are appreciated chiefly by the touch, though this is often assisted by sight and occasionally by hearing. They chiefly refer to those alterations in the position of prominent points of bone which are produced either by violence in fracture or dislocation, or by muscular action in diseases of joints, and in some affections of bone. In the exploration of the abdomen for tumour or to diagnose the seat of obstruction, and in exploration of the chest with reference to the diagnosis of fluid in the pleura, the ear also comes into play. Beside the actual changes in position, changes in the direction of bones become sometimes of much consequence, as in the diagnosis of dislocations of the shoulder. In some chronic diseases also the relations of parts undergo changes which it is of the utmost importance to anticipate and discover. A notable instance of this is the displacement which the femoral artery sometimes suffers in chronic abscess of the thigh, where the vessel has been wounded by the very care which has been taken to make the incision away from its normal course.

Mobility.—Alterations in mobility depend on the solutions of continuity of bones, ligaments, or fasciæ, on the one hand, whereby parts which ought to be fixed become movable; or, on the other, on chronic inflammation, leading to adhesion or ankylosis, by which movable parts become fixed. The most common illustration of unnatural mobility is that of fracture; and perhaps the most perfect instance of the diagnostic value of loss of natural mobility is in early disease of the hip. When other symptoms might be doubtful, the contrast in mobility of the sound and diseased joint will usually at once clear up the case.

Pulsation.—The alterations in pulsation have been already spoken of, under the symptoms referable to the organs of circulation. Every opportunity should be taken of studying the various kinds of unnatural pulsation which are noticed in diseased vessels, and of verifying by post-mortem examination the morbid conditions on which they may depend; such as the expansive pulsation of ordinary aneurism, the obscure thrill of extravasation depending on ruptured artery, the vibrating and purring thrill of arterio-venous aneurism, the tremulous movement often perceived in the large arteries (chiefly the abdominal aorta) in anæmia.

Sound.—The faculty of hearing is to be employed in many parts of surgical diagnosis, although it may be less important than in medical diagnosis. The use of the stethoscope ought never to be neglected; and every opportunity should be taken for becoming familiar with the healthy and morbid sounds, and for tracing on the dead body the causes upon which the latter depend. The great importance of the bruit in the diagnosis of aneurism is the most striking instance of the employment of the ear in surgery; but it must not be forgotten that aneurisms exist without bruit—in fact the most numerous class of aneurisms, the thoracic, are very frequently devoid of all sound—and that also (but much more rarely) bruit exists without aneurism, as in a few cases of pulsatile malignant tumour (vol. iii. p. 455), or of tumours pressing on large arteries (ibid. p. 453). In cases of suspected stone, the ear gives the most definite and unmistakable evidence of the presence of the foreign body. In necrosis the ring of the probe against the hard exposed bone is very characteristic. In cases of injury to the thorax auscultation becomes occasionally indispensable; and in a few other circumstances the sense of hearing furnishes useful data.

Smell.—The province of this sense in diagnosis is very limited, since, though peculiar odours are associated with many morbid conditions, their other symptoms are quite sufficient to distinguish them, or if not the diagnosis could not be established by the odour. Perhaps favus may be an exception, in which the peculiar mouse-like smell is considered as a characteristic of great value. Some surgeons attribute much importance to the smell of matter discharged from a sinus, as indicating, by a peculiar sanious odour, that it proceeds from a carious surface of bone; but too much stress should not be laid on this.

Chemical examination.—The province of chemistry in establishing the diagnosis of surgical ailments is not very extensive, although in confirming that diagnosis, and in suggesting a rational plan of treatment, it is frequently useful. In urinary diseases, indeed, some chemical examination of the secretion is necessary: and the same may be said in cases of stone: but there are few other instances in which chemical analysis is necessary in the ordinary exigencies of surgery. In medical jurisprudence, however, chemical examination is indispensable in almost every case.

Such are the chief sources of surgical diagnosis; and in order not to overlook any of them in examining the cases which come before him, it is useful for the student at the commencement of his practice to be prepared with a form which may embrace them all, and suggest them to the examiner. Such forms are still more useful in the registration of hospital-cases, where reference is so much facilitated by uniformity of system. Accordingly, I have subjoined a form for the registration of cases, which was devised by Dr. Bristowe, to whose kindness I am indebted for its insertion. It has been in use for some years at St. Thomas's Hospital, and is adapted both to medical and surgical cases. An example of a case of either kind is inserted on the form. These forms are intended to serve also as indexes to the detailed notes of the more important cases, which would of course be taken at considerable length, and numbered. These detailed notes are to be marked with the same number as is prefixed to the column appropriated to the tabulated case. Thus a reference to the symptoms connected with any of the main headings in the table would at once give all the morbid phenomena connected during life with each organ or system of organs. The post-mortem register is to be arranged on the same plan, and a second reference to it would give all the morbid appearances with which these phenomena are associated. Thus, if the lines are traced horizontally, they give a succinct account of the morbid conditions of the various organs, and references to a more accurate and detailed account of those conditions when necessary; while, if the columns be read vertically, they give a succinct account of the symptoms connected with each particular disease, and (as before) a reference to a more copious account when necessary.

TABLE FOR REGISTRATION OF MEDICAL AND SURGICAL CASES.

	1. Disease for which admitted - Duration.	1st attack. 1. Acute rheumatism. 3 weeks.	Acute necrosis of femur. 12 hours.
	2. Associated disease. Duration.	2. Mitral-valve disease.	Pyæmia.
	3. Result.	(1) Cured. (2) Nil.	Dead.

TABLE *continued.*

	4. Sex. Age. Occupation.	F. 16. S. Servant.	M. 5½. Child.
	5. Date of Admission. Date of Discharge. No. of days in Hospital.	Dec. 9. Jan. 24. 46 days.	March 29. April 9. 11 days.
NERVOUS SYSTEM.	Brain.	Want of sleep at times from pain.	No sleep last 6 or 7 days; sensible to last
	Spinal cord.		×
	Nerves.	Pain in many joints (shifting); pain in chest.	Severe pain in right thigh, and left side of face; and for short time in left wrist.
	Organs of sense.	×	×
ORGANS OF RESPIRATION.	Larynx and trachea.	×	×
	Lungs.	Slight cough on admission.	Severe incessant loose cough last 3 days with short breath. Chest resonant.
	Pleuræ.	×	
	Expectoration.	×	None.
ORGANS OF CIRCULATION.	Heart.	Increased area of dulness (? effusion). No friction. Systc. m. at apex 11 d. after admission, persistent.	—
	Pericardium.		—
	Arteries.	P. regular; quick.	P. about 160. Imperceptible last day.
	Veins and capillaries.		
	Blood.		
	Lymphatic system.		
ORGANS OF DIGESTION.	Tongue, mouth, and salivary glands.	T. furred on admission and for some time after.	T. moist, but furred. Last 2 or 3 days dry.
	Fauces, pharynx, and œsophagus.		Abscess on L. side in neighbourhood of fauces: opened day before death.
	Peritoneum.		×
	Liver.		No jaundice.
	Spleen, thymus, thyroid, and S. R. capsules.		

Table *continued.*

ORGANS OF DIGESTION.	Stomach.	Thirst and bad appetite when admitted and for some time after. Gastrodynia.	Want of appetite. No sickness.
	Vomitus.		
	Intestines.	×	B. not loose.
	Dejections.		
	Kidneys, &c.		
URINARY ORGANS.	Bladder and urethra.		
	Urine.		
SEXUAL ORGANS.	Male organs.		
	Ovaries.		
	Other female organs.		
LOCOMOTIVE ORGANS.	Muscular system.		Very feeble.
	Osseous,		Acute necrosis of nearly whole femur; opened 7th d. Acute necrosis near ramus of jaw. (Lt.) beginning Apr. 1st; opened Apr. 6th.
	Articular, and	Pain, redness, and swelling of many joints.	
	Fibrous systems.		
	Adipose and areolar tissues.		
	Integuments.	Perspiration.	Skin dry all along. A few sudamina.
	Aspect.		Face much flushed at beginning. Aspect of typhus.
	Operations and date of operations.		
	Remarks.	Treated with lemon-juice, then with potash, and occasional hot-baths.	Complained of illness 12 hours only before admission. First symptoms, pain in thigh, coming on without obvious cause.
	Name of patient. Medical officer. Reference.	M. M. Lack. Dr. —— ——	J. Scully. Mr. —— ——

1. Duration, in the first two lines, is intended to be duration up to the time of entering hospital.

2. Practically, it has been found convenient to place information relating to 'pain' (neuralgic, or of other kind) under the head of nerves.

3. Where two lines are bracketed the intention is that, in cases where it is impossible conveniently to separate the description of the two or three organs thus bracketed, the combined description shall either extend over the whole space or be limited to the central part of the space.

4. Where more than one organ or tissue is involved in the same disease, the fact should be repeated under each head; thus, when *joint-disease* is mentioned under its appropriate heading, it will be often proper to mention *caries* under the head of bones.

5. It is sometimes desirable to give the duration of a symptom, or the time at which it commenced or ceased. This may be conveniently done by making the day of admission the starting-point of reckoning, and by speaking of time in days; thus, duration, 14 d. to 16 d., indicating a duration of three days inclusive, beginning from the 14th day after admission; or, 3 d. to 2 d., indicating a duration of five days inclusive, beginning from three days before admission.

6. A *line* placed under any remark indicates that the condition to which it refers is *important* or *grave*. And the degree of gravity may further be roughly indicated by the degree of thickness of the line.

7. A cross placed in any space indicates that the organ or part to which it refers was ascertained to be healthy.

8. A horizontal line similarly placed indicates that, from some oversight, the condition of the part to which it refers *was not* ascertained.

9. A D or an M placed in the corner of a compartment is used to signify that the notes of the case contain a *detailed* description or a detailed *microscopic* account relating to the circumstances contained in the compartment.

The importance of anatomical knowledge and anatomical examination in surgical diagnosis is greater than that of any other of the sources of diagnosis. This will be best illustrated by the following remarks on REGIONAL SURGERY.

REGIONAL SURGERY.

The object of the following pages is to give, in as few words as possible, the main considerations by which the surgeon ought to be guided in distinguishing from each other the affections of the various regions of the body, so far as those considerations depend on the structure of each region. Such a treatise, if completely executed, would embrace all the points at which surgery and anatomy touch each other, and would therefore extend over the greater part of the theory of surgery; but, as most of these points have been fully treated of in the body of this work, it will suffice for me here to give a general view of the leading features of the anatomy of each region, and to dwell more particularly on such diseases * as have not found a place in the previous pages.

Of the Head.

The regional anatomy of the scalp and skull is simple. The parts present merely a series of laminæ overlying the cerebrum. These laminæ may, for surgical purposes, be divided into the hairy scalp, including the skin and the tendon of the occipito-frontalis muscle, with the large vessels contained between them;

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* It must be remembered that all injuries will be found in our second volume, described in the same regional classification as that which is here adopted.

the cellular interspace between this tendon and the pericranium, in which the smaller vessels ramify; the pericranium and skull; and the membranes of the brain. It is unnecessary to attempt here any summary of the well-known points connected with the normal anatomy of these various structures. The point of chief importance in the case of any morbid product in this region is to determine from which of the laminæ it has sprung. This knowledge will of itself frequently determine the nature of the disease, and will at any rate give the most valuable indications as to the possibility of surgical interference.

1. The affections of the superficial layer—the hairy scalp—do not, as a general rule, lead to any difficulties in diagnosis; nor need the reader be detained here by observations on such affections as erysipelas, the cutaneous eruptions, the ordinary forms of nævus, of innocent tumour, or of cancer—affections which have been treated of in other parts of this work.* Two only of the diseases of the scalp and its subcutaneous tissue appear to me to require notice here—viz. the congenital encysted tumour perforating the skull, and some of the rarer forms of vascular pulsatile tumour.

The congenital cutaneous cysts have been referred to in the essay on TUMOURS, vol. i. p. 514. Their frequent occurrence in the orbit, and their occasional communication with the cranial cavity, have been noticed in that essay. A similar (but usually larger) perforation sometimes exists in the skull, below a tumour resembling in all respects, before removal, the ordinary sebaceous tumour of the scalp, but congenital. It is not to our present purpose to discuss whether the hole in the bone is the result of pressure while it is in a membranous condition, or of original imperfect development. The practical effect is the same, viz. that the tumour lies on the dura mater. The removal of the tumour is not on that account to be absolutely discountenanced, but its important relations call for increased care in the diagnosis and treatment of such of these tumours as are congenital. They are generally brought under the surgeon's notice in childhood. The main questions, in a case of congenital tumour of the scalp, are, first, whether the tumour is dermal or encephalic; secondly, allowing it to be dermal, whether it perforates the bone or no. Great care should be taken in examining any congenital tumour lying in any of the ordinary situations of encephalocele; and if such a tumour (not being a nævus) partakes in any obvious degree in the respiratory movements, still more if pressure produces any evidence of cerebral disturbance, it is far more wise to abstain from interference, except in case of evident necessity; such as the extension of the growth downwards, and the onset of more evident cerebral symptoms; when an operation may be proposed as a last chance, after its dangers and uncertainties have been clearly set before the child's parents. A tumour in other parts of the scalp, which is rounded, movable, non-vascular, not swelling up with crying, coughing, &c., and in which pressure does not affect the brain, may fairly be pronounced dermal. In a few such tumours, the finger-nail insinuated underneath the base will detect a depression in the skull. Since the depression may be due to perforation of the outer table only,† it does not absolutely contra-indicate operation; but it would be advisable before operating to be satisfied of the decided increase in size of the tumour. Even if no depression can be felt, the skull may still be perforated; so that great caution should always be used.

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* I may perhaps notice that almost all the affections of the scalp are essentially cutaneous, and that the malignant affections are exceedingly rare. Almost all tumours are of the encysted variety; but I have met with a fatty tumour here.

† Mr. Athol Johnstone mentions four cases of these perforating sebaceous tumours. In one, at an operation for sebaceous tumour of the scalp, the bone was found perforated, the dura mater was injured, and the patient died. The case occurred abroad. The preparation was presented to the Royal College of Surgeons by Mr. Prescott Hewett. In two other cases, Mr. Johnstone, in dissecting out sebaceous tumours, found a small perforation in the bone beneath them. No ill consequences occurred. In the fourth case, in an infant who died from other causes, a sebaceous tumour was found lodged in a depression in the bone just above the orbital arch, but not perforating the bone (*Lectures on the Surgery of Childhood*, p. 15). M. Giraldès has published, in his *Leçons cliniques*, p. 342, an account of a singular case of congenital dermoid tumour of the skull, lying over the anterior fontanelle, and which was long

With respect to the pulsatile tumours of the scalp, which are formed by dilatation of the large arteries below the skin, their anatomy and treatment has been described in the essay on ANEURISM, vol. iii. p. 534;* and an allusion has been made to the occasional difficulty of distinguishing them from malignant tumours of the skull, in the essay on DISEASES OF THE BONES (ibid. p. 808). The presence of cerebral symptoms on pressure is a clear diagnostic mark, and ought absolutely to forbid any operative interference; but any appearance of morbid action in the skull at the seat of the tumour—more particularly thickening without signs of inflammation—should render the surgeon very cautious in his diagnosis.

2. The occipito-frontalis tendon forms, in an anatomical description, the second of the layers of tissue which protect the brain: but as the surgical affections of this tendon could not be distinguished from those of the skin to which it is firmly attached, it may be neglected in this place. We come then to the cellular interspace between the tendon and the pericranium, to which the tendon stands in the same relation as the deep or muscular fascia does to the cellular interspaces in the other parts of the body. In this interspace the most ordinary affection is the diffuse inflammation so common after scalp-wounds; but this has been already treated of in the essay on INJURIES OF THE HEAD, vol. ii. p. 246. Effusions of blood sometimes take place in the same space, and lead to interesting questions of diagnosis and treatment. Such effusions, as far as I have seen, occur only in early childhood, and are probably always the result of accident: although the occurrence of the blow or fall may not always be known, since no mark may have been left. The fluctuating swelling may extend over the whole scalp, or over a large part of one side of it, being generally more prominent in the temporal region.

When this blood-tumour extends over the whole head, I have seen it mistaken for hydrocephalus—from which, however, there should be no difficulty in distinguishing it; since the forehead has not the characteristic shape of that disease, the bones are not thrust out, and the skull can generally be detected underneath the fluid. From cephalæmatoma it may be diagnosed by its position, since the latter is confined in ordinary cases to the parietal bone; by the history—the one being congenital, the other usually not; and by the absence of the defined ridge which encircles a cephalæmatoma. When a large artery has been injured, these blood-swellings sometimes pulsate, and increase very rapidly in size, so as to require active treatment. Two courses are then open: either to cut across the swelling, and endeavour to find the wounded vessel; or to tie the vessel at a higher point. The latter course is only possible when pressure on some branch (most probably one of the superficial temporal arteries) will arrest the pulsation. In such a case Mr. Athol Johnstone tied the tem-

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mistaken for a meningocele, in consequence of the peculiar nature of the fluid evacuated from it by puncture. This was so precisely identical with the cerebro-spinal fluid that M. Giraldès, having punctured a spina bifida on the same day, was unable to distinguish any difference between their contents. However, at last, as he made no progress in the treatment of the case by repeated puncture and application of pressure, he determined to lay open the tumour. A flap was formed from the skin of the scalp, and then the tumour was exposed and opened. It was now discovered that there was no communication with the skull, and the cyst was therefore removed entire with perfect success.

* In speaking of the treatment of aneurism by anastomosis in that essay, I accidentally omitted to refer to Mr. Southam's case, published in the *Med.-Chir. Trans.* vol. xlviii. in which the disease was successfully treated by a combination of the ligature of the common carotid artery and the use of setons. Mr. Southam informs me that Mr. Nunneley and another surgeon have also treated cases successfully in the same way.

poral artery with complete success. The tumour was of large size; and to have laid it completely open and evacuated the contents would have been a severe operation, and possibly might have been accompanied by a good deal of hæmorrhage.

In ordinary cases little treatment is required.* Under the use of evaporating lotions, the tumour gradually subsides. But if it continues in a chronic condition, it is justifiable to puncture and empty it; employing at the same time carefully-adjusted pressure. I once treated such a case in this manner, and had the opportunity of dissecting the parts a few months afterwards, the child having died of another disease. I found no traces of the collection of blood, except some decolorised fibrin and a few stratiform clots, bound down by a layer of false membrane.

3. The next layer of tissue is formed by the pericranium and skull. The blood-tumour, which is produced by pressure on the infant's head during delivery, and which is called cephalæmatoma, is smaller than the subaponeurotic extravasations above spoken of, appears in a few hours after birth, is situated on the parietal bone, and is bounded by a distinct ridge. The same ridge, bounding a small round circumscribed collection of fluid, is also familiar to surgeons as a frequent symptom in blows on the head, and a frequent cause of mistake to inexperienced observers, who confound these appearances with those of depressed fracture (see vol. ii. p. 255). Such extravasations from blows always disappear spontaneously; nor is there any more reason for surgical interference in cases of cephalæmatoma.†

The affections of the skull are by far the most frequent and the most important of those which attack this region. They may be divided into—1. the results of simple inflammation, acute or chronic; 2. scrofulous affections; 3. syphilitic affections; 4. tumours, innocent or malignant. Possibly also simple hypertrophy might be added to the list; but I have never been able to satisfy myself of the existence of this affection apart from the results of chronic inflammation.

The diagnosis and treatment of these affections may be thus stated in a tabular form:—

[*See Table on pp.* 966–7.]

4. After the affections of the skull come those diseases of the cranial contents which fall under the notice of the surgeon; that is to say, the tumours projecting through the cranium. Inflammatory affections of the meninges arising from constitutional causes, and the distension of the membranes or of the ventricles of the brain from hydrocephalus, come more properly under the notice of the physician; nor can we here enter upon the wide question of their diagnosis and treatment. The intracranial inflammations which follow injuries are treated of at vol. ii. pp. 338 et sqq. Our present subject will comprise congenital tumours arising from malformation (meningocele and encephalocele), and the numerous forms of tumour which were originally described by Louis as fungous tumours of the dura mater; to which a few words on chronic hydrocephalus must be added, in order to illustrate and explain the surgical operation of paracentesis capitis.

Encephalocele and meningocele are tumours formed by a hernia of the membranes of the brain through the skull, in one of the parts where the bones are deficient in early life. In encephalocele a portion of brain also lies outside the skull, while in meningocele nothing protrudes except a bag of the membranes filled with subarachnoid fluid.

The tumours so formed are soft, rounded, bluish in colour where covered by thin skin,* and from their congenital formation, their colour, and their increase in size when the child cries, are often mistaken for nævus. It is also often difficult to distinguish them from congenital encysted tumours, and sometimes perhaps impossible before operation.†

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* On the treatment of blood-tumours reference may be made to the essay on CONTUSION, vol. i. p. 625.

† For a more full account of cephalæmatoma the reader is referred to Dr. West's *Lectures on the Diseases of Infancy and Childhood.*

The pathological anatomy and diagnosis of such tumours is an important and interesting question, to which much attention has been paid by Mr. Prescott Hewett, who has explained the subject very clearly in a course of lectures delivered by him as Professor of Surgery at the College of Surgeons, but not yet published.‡ I cannot affect to add anything to the information then first collected on this head, nor in the space at my command even to adequately sum up all the points connected with it; but must be content if I can succeed in indicating those which are of the chief practical importance.

That which appears the leading consideration in the anatomy of these hernial tumours is the condition of the contained organs; since if these could be known or assumed to be healthy, treatment might be justifiable, and vice versâ. It is important, therefore, to know that in hernial tumour of the skull, even if nothing but the membranes protrude, yet there is almost, if not absolutely, always more or less of internal hydrocephalus. In a preparation in the Museum of St. George's Hospital a cyst is seen adhering to the skull by a pedicle which runs down to the anterior fontanelle, the situation of the fontanelle being occupied by a large Wormian bone, which nearly closes it.§ The pedicle of the tumour is entirely solid, and the cyst was punctured during life without any detriment, though without benefit. From the length of the pedicle, and the perfect closure of the orifice of communication, there can be no doubt that this tumour might have been removed by operation with fair prospect of success, in fact the meningocele may be said to have been spontaneously cured. Yet the patient died at the age of six weeks; and on examination there was found a large collection of fluid circumscribed in a part of the arachnoid cavity, and communicating with a dilated lateral ventricle through an opening in the distended corpus callosum. In another preparation in the same Museum, the cyst which is in the occipital region contains no brain, but it leads through a small opening into the cavity of the fourth ventricle, which, as well as the whole ventricular cavity, is enormously dilated. In a case which I treated by iodine injection, and in which the infant died from another cause, the same dropsy of the ventricles existed. The case is described and figured in vol. i. of the *St. George's Hospital Reports*, and the preparation is also in the Museum of the Hospital. Therefore, in the case of infants, the first point to be remembered is, that there is every probability of the presence of internal hydrocephalus; and it is not until the perfect mental and physical power of the patient is ascertained, by long watching of the case, that the question of surgical treatment ought to be discussed.

The next question of primary importance in the anatomy of such a tumour is, whether or no the brain protrudes into the sac. It is only seldom that the pulsations of the brain can be detected: ‖ when this is the case, there can be no doubt of the existence of hernia cerebri; but in ordinary cases where no such pulsation is found, there is no reason whatever for assuming the absence of the brain from the sac. The mass of fluid lying over it may mask its pulsation, or the protruding portion of brain may be only a small piece rising just up to or just beyond the level of the skull.

The situation of such tumours is very variable. The most common is in the middle line, and usually at the back of the head, through an opening

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* In these tumours, as in spina bifida, the cutaneous covering may be deficient, and the membranes exposed; but this is still more rare in the head than in the spine. Bruns. *Hand. d. prakt. Chir.* vol. i. p. 701.

† See the case referred to in the note on p. 962.

‡ The best published account of this subject is to be found in the work of Bruns above referred to.

§ A drawing of the head, taken during life, is also in the Museum.

‖ As in Mr. Shaw's case, in *Path. Soc. Trans.* vol. ix. p. 1.

TABLE OF THE CHIEF SURGICAL DISEASES OF THE SKULL AND PERICRANIUM.

DISEASE.	LEADING SYMPTOMS.	DIAGNOSIS.	TREATMENT.
Acute inflammation: periosteal.	Very severe pain, especially nocturnal; sense of tension; much tenderness; slight swelling, bound down firmly by pericranium.	From tumour of brain or membranes by its more rapid course, and absence of cerebral symptoms. From simple cephalalgia or neuralgia, by the swelling, the persistence and regularity of the symptoms; and the constitutional disturbance. From the following, by the absence of suppuration and of symptoms of implication of the brain and membranes.	Free incision into swelling, with constitutional measures.
" " osteal (acute necrosis)	As above: with rapid formation of pus, and probably irritation or suppuration on the other side of the bone, with cerebral symptoms. In rare cases, ulceration of the middle meningeal artery occurs, followed by hemiplegia.	This may be inferred from the preceding.	Free incisions. Trephining is imperative, when symptoms of pressure are clearly marked, and may be justifiable in some cases of mere irritation.
Ulceration.	Inflammation, with suppuration,* followed by perforation of the skull, and, in rare cases, hernia cerebri.	In rare cases, when hernia cerebri occurs before the skin has given way, the disease has been mistaken for malignant pulsatile tumour. V. infra.	To attend to the general health and relieve pain by incisions where fluid is apparent.
Chronic inflammation and hypertrophy	Rarely any symptoms: coma has been observed occasionally; but its connection with the state of the skull has not been demonstrated.	Obscure.	No treatment is possible, except for the brain-symptoms, which (as their cause would be obscure) must be treated as they arise.
Nerosis and caries		Obvious.	When symptoms of cerebral irritation are present, the bone (especially when not implicating the whole thickness of the skull) may be removed.
Scrofulous affections: †	A large hard swelling, on the side of the head, much resembling an exostosis;	From diffused exostosis, by the less-circumscribed character of the swelling,	Blisters or iodine to the part. Iodine,

Syphilitic affections† of the internal table.	Circumscribed pain in head; irritation of membranes, producing fits, and in rare cases hæmorrhage from middle meningeal artery; with other symptoms of constitutional syphilis.	From syphilitic disease of the brain itself‡ only to be diagnosed with certainty by a surgical operation.	When life is seriously threatened it will be justifiable to trephine at the seat of pain; or, in still more rare cases, over the middle meningeal artery.§
Tumours: innocent: exostosis.	A small and very hard tumour growing very slowly, and unaccompanied by any symptoms except in very rare cases, when the exostosis grows from both tables, or in the orbit when it displaces the globe.	From diseased enlargements of the bone by the presence of symptoms in the latter, and by their less distinct and circumscribed outline.	Operative interference is seldom justifiable.
fibrous or fibro-cystic.	A slowly-growing tumour, more soft than exostosis, and more liable to affect the brain by growing inwards.	From exostosis as above: from cancerous tumours by its less rapid growth, and by the other usual diagnostic marks; from fibrous tumour of the dura mater the diagnosis is obvious before perforation of the skull has taken place, but impossible afterwards.	No interference is permissible. Life may be prolonged many years even after the tumour has produced pressure on the brain and cerebral symptoms.
myeloid or fibro-plastic.	The same observations apply to the symptoms, diagnosis, and treatment of these forms of tumour, with the exception that their course is more rapid, and that in all other respects they bear a closer resemblance to malignant disease.		
malignant.	Circumscribed pain in head; soon followed by the appearance of a tumour, or by softening and pulsation at the seat of pain. The tumour grows rapidly, and soon produces pressure on the brain. The malignant cachexia is usually well marked. The skull is usually thickened around the tumour.	From innocent tumour by its more rapid course, and by the constitutional symptoms. From hernia cerebri, following absorption of the skull (very rare), by the greater violence of the pulsation, the absence of the movements of the brain dependent on the respiration, and the less uniform consistence of the tumour. From vascular tumour (or aneurism by anastomosis), by the cerebral symptoms which are induced by pressure, as well as by the signs of cancer.	No treatment is possible.

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[*] In one case, much resembling ulceration of the cranium, there seems to have been no suppuration previous to the incision. See Cæsar Hawkins, in *Med.-Chir. Trans.* vol. xxxix. p. 289.

[†] The ordinary constitutional affections are not mentioned, as they are merely the common inflammatory affections *plus* those of the diathesis.

[‡] Such as described and figured by Mr. H. Lee, *Proc. of Med.-Chir. Soc.* vol. iii. p. 283; *Path. Soc. Trans.* vol. x. p. 8.

[§] See a case by Mr. H. Lee, *Med. Times and Gaz.* Jan. 29, 1859.

in the occipital bone behind the foramen magnum, at the junction of the four centres which form 'the proral portion' of that bone; but any of the membranous portions of the infant skull may yield to the pressure of the fluid collecting inside, and become the seat of the hernia. Thus encephalocele is seen at the root of the nose (between the two halves of the frontal bone), at the anterior or posterior fontanelle, between the frontal and sphenoid or temporal bone, &c. The tumours in the anterior and superior regions of the skull communicate with the lateral ventricle; those in the lateral region with the lateral or the third; those in the occipital region with the fourth ventricle. Hernial tumours have also been found in the base of the skull, probably communicating with the third ventricle.* A short time since a tumour was presented to the Pathological Society by Dr. Lichtenberg,† which he had removed from a child's mouth, into which it projected from the pharynx, hanging out over the chin, so as to touch the sternum. This turned out to be a hernia of the brain through the base of the skull. The operation of course proved fatal.

The diagnosis of these tumours rests, first, upon their congenital occurrence and position, at one of the membranous portions of the fœtal head; next, upon their fluid nature; thirdly, upon their considerable and decided increase in volume or tension with strong expiratory efforts; fourthly, upon their reducibility in part or entirely; and fifthly, upon their sharing in the motions of the brain. All the three latter marks will be absent from those tumours in which (as in the instance quoted above) the pedicle has been obliterated; but such tumours cannot be accurately diagnosed. Another source of difficulty in diagnosis is that these hernial tumours are occasionally multilocular, and then the fluid is not reducible. This was the case in my patient, referred to above, p. 965. In some other cases also, the diagnosis must be allowed to be very difficult. I have seen a congenital tumour, lying on the root of the nose, and rightly believed to be a common encysted tumour, in which, however, before operation, it was impossible to be quite certain of its nature. In another case the hernial tumour was cut into, in mistake for a sebaceous cyst, and a small portion of brain-substance, proved to be so by microscopic examination, was removed. Fortunately no harm ensued.

As to treatment, few surgeons would propose to meddle with a hernial tumour of the brain, knowing it to be such, unless it was distinctly increasing, and the patient's life was obviously imperilled. Unfortunately this is just the case in which there would be least prospect of benefit; since the rapid increase in the tumour depends, in all probability, upon the rapid secretion of fluid from the lining-membrane of the ventricles or the arachnoid; and the obliteration of the tumour, if it could be effected, would only hasten the epoch of fatal pressure. But, in some very rare cases, it may be thought justifiable to interfere, even if the tumour is known to be connected with the interior of the skull, since it may be growing so rapidly, and be so near bursting, that it may seem more dangerous to leave it alone than to operate on it. In such cases puncture of the swelling, and carefully adjusted support (rather than pressure) afterwards by means of a pad and bandage, of such materials as may be judged best, are the most advisable operative measures. Tumours of this kind have been removed by excision and ligature, having been mistaken for other growths; but this is a course which should only be knowingly followed in the very rarest cases. In all cases it is advisable to give careful support to the tumour, and to defend it from irritation or injury; and in those tumours which are reducible, if no cerebral symptoms are produced by their reduction, an apparatus should be employed to keep them down to the level of the cranium. This has sometimes been followed by the ossification of the skull-cap and the cure of the disease.‡ Injection of iodine has been tried, as in spina bifida, but hitherto, as far as I know, without benefit. Mr. Paget treated a case in this way, without any very obvious result, though the disease remained stationary for a length of time afterwards.* I have already referred to a case under my own care, in which also the injection, though frequently repeated, produced no effect on the tumour. In that case, had not the child's life been cut short by an accidental attack of bronchitis, I intended to have attempted the excision of the tumour.

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* Serres, *Journ. de Chir. par Malgaigne*, 1844, vol. ii. p. 335.

† *Path. Soc. Trans.* vol. xviii. p. 250.

‡ Bruns, op. cit. p. 715.

Tumours of the dura mater and diploë.—Since Louis wrote his celebrated memoir on fungous tumours of the dura mater,† the attention of surgeons has not ceased to be directed to those perforating tumours of the head which he described under that name. It is obvious on reading that paper,‡ as well as on studying the specimens of such tumours preserved in our Museums, that several different kinds of tumours are included under this designation. They differ in nature, some being innocent and some malignant; and in origin, some being originally connected (as Louis thought they all were) with the dura mater, and others with the bone, having usually their primary seat in the diploë; but they agree in certain main leading characteristics, can hardly be diagnosed from each other except under very rare circumstances, and must be carefully distinguished from other forms of tumour. The main features on which their diagnosis is to be founded are, their noncongenital history, which distinguishes them from nævi and from hernial tumours; and their penetration of the skull, which distinguishes them from aneurism by anastomosis and from ordinary solid tumours. This penetration is manifested by the cerebral symptoms which pressure on their surface produces, and by the pulsation which they either receive from the subjacent brain, or which those of them that are malignant and spring from the diploë may have in their own vessels. Sometimes the edge of the opening in the skull can be felt. They are seldom very prominent—often are hardly raised at all above the surface of the skull, but feel like softened pulsating spots in the bone; and they are either single or multiple. Those which are little, if at all raised, have been sometimes described as aneurisms of the bone.§ Those tumours which pulsate actively, and especially those which are multiple, will usually be found to be soft cancer of a very vascular kind springing from the diploë. Those which receive pulsation from the brain are either soft cancer, or fibro-cellular or fibrous tumours, affecting the dura mater, and perhaps originating in it. Some of them, however, affect the bones of the skull to an equal or even greater extent, so that it is not easy to form an opinion as to their origin. A symptom which is often of value as distinctive of tumours penetrating the skull, but which is only met with at an early period, is the presence of a thin crackling parchment-like layer of bone over the tumour.

Some of these tumours have been met with, which have been entirely reducible within the skull. Nélaton ‖ gives a remarkable case, in which several such tumours formed, and disappeared temporarily, but grew again and proved to be cancerous.

If the question of the treatment of such tumours needs discussion, little can be said beyond urging the propriety of not meddling with them. This again might seem almost unnecessary; but it is surprising how often, either from mistakes in diagnosis, or from inability to resist the patient's entreaties, surgeons do commit themselves to an attempt at such operations. Such attempts, however, are unjustifiable on every ground. It has been stated above that these tumours are innocent or malignant. In the former case, an operation will probably hasten death; and in the latter, it will certainly not retard it. The innocent tumours are by no means necessarily fatal.[*] No operation could be of any avail short of one which would remove the whole of the skullcap around the diseased parts, and allow of the avulsion of the tumour from the dura mater; and although instances of recovery from such barbarous proceedings are on record,[†] they would not now be attempted. But to cut into a tumour of this sort, with no prospect of removing it entirely, is surely still less justifiable. In cancer no operation should ever be thought of, unless there is almost a certainty of removing the whole disease; and this rule is the more absolute, the more vital the organ is in which the disease occurs.

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* *Path. Soc. Trans.* vol. xvi. p. 12.

† Translated by Mr. Drewry Ottley in a volume of selections from the Memoirs of the Academy of Surgery of Paris, published by the Sydenham Society.

‡ Compare the cases numbered 1 and 19.

§ E.g. by Cruveilhier, *Anat. path.* liv. 33, pl. 4.

‖ *Path. Chir.* vol. ii. p. 631.

Hydrocephalus.—Surgeons are sometimes consulted with respect to surgical measures in cases of chronic hydrocephalus; and hence it becomes necessary to say something in this place about this disease, as far as relates to its surgical treatment. The acute affections of the brain (encephalitis, acute hydrocephalus, or strumous meningitis, &c.) are so exclusively the province of the physician, that they will not be mentioned here; more especially as it would be impossible to do justice to the subject without more space than is at my command. The effusion in chronic hydrocephalus may be external or internal to the ventricular cavity; it may depend on malformation of the brain, on atrophy, on chronic inflammation, or on injury; and the curability of the disease depends so essentially on these circumstances, that they must be maturely weighed before an opinion for or against surgical interference is given. Cases of external hydrocephalus (i.e. of dropsy of the arachnoid cavity) are usually regarded as less hopeless than those of dropsy of the ventricles. The diagnosis of the two conditions is by no means certain in any case; in fact, Dr. West [‡] says that their symptoms are nearly identical; but some indications can be drawn from the history, and a probable guess at any rate may be formed from the appearance of the eyes. In those cases of hydrocephalus which are congenital there is usually extensive malformation of the brain, and the fluid may be expected to be found in the cavity of the ventricles, although it is not unlikely that there may also be fluid external to the brain. At any rate treatment will be useless. In cases, on the other hand, which can be clearly traced to injury, the probability will be that the fluid is external; and there will be more hope from treatment. In atrophy of the brain, the hydrocephalus will be external; in chronic inflammation, internal; but I know of no symptoms or facts from which these conditions can be diagnosed.

The aspect of a case of hydrocephalus is very peculiar. The fontanelle is widely expanded and often very tense; the sagittal and frontal sutures are opened out, and thus the two halves of the frontal bone are driven outwards, and the frontal eminences project on either hand, giving a peculiar square shape to the head, and great height to the forehead. The base of the skull is driven downwards; and thus the orbital plates of the frontal bone are pushed into the orbit, displacing the eyes, which look outwards and downwards, and are also more prominent than natural. Frequently, also, the eyes have that unsteadiness of action and vacant expression which accompanies partial blindness in infancy. The occiput is driven more or less downwards and backwards. On feeling the head, in an old-standing case, isolated patches of bone (Wormian bones) will often be felt in the sutures. Very large veins ramify over the thin scalp, and the fluid often shines through its attenuated coverings.

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[*] There is in St. George's Hospital Museum a preparation showing a fibrous tumour of the skull and dura mater, which had perforated the latter membrane and was lying on the brain, from which it received a very decided pulsation. The patient suffered from occasional fits, loss of memory, vertigo, and sickness; but he survived the appearance of the tumour more than fifteen years; and finally died, at a tolerably advanced age, of a disease quite unconnected with that on the skull.

[†] Louis, op. cit. obs. 19, p. 114; a case in which a piece of bone, six-and-a-half inches in circumference, was removed by the application of numerous crowns of trephine on several occasions; and a 'fungous substance' was said to have been removed from the dura mater. The whole description and history, however, seem to show that this was merely a case of caries of the skull, and the fungous substance only the product of inflammation.

[‡] *Lectures on the Diseases of Infancy and Childhood*, lect. ix.

Of these characters, the position of the eyes is different in external and internal hydrocephalus, inasmuch as the displacement of the base of the skull depends mainly on accumulation in the ventricle; and therefore the eyes are less likely to be driven out, when the fluid is confined in the cavity of the membranes, since in all recorded cases the accumulation in external hydrocephalus has been limited to the vertex of the skull.*

Surgical treatment.—If the child be in fair general health, and not obviously beyond hope of relief, the question occurs whether mechanical means will be of any avail in checking or removing the effusion. I am not aware that any success has attended the use of internal remedies. I have often made patient trial of mercury, and believe it to be quite inert, as far as procuring any reabsorption of the fluid goes. Nor can I say that I have found any benefit from mercurial or other applications to the scalp. Pressure on the skull, or puncture of the fluid collection (paracentesis capitis), are the only means which hold out any rational prospect of benefit; and although I cannot recall any case of success under my own observation, I do not dissuade their use whenever the disease is not congenital, or accompanied by other malformation, or complicated with symptoms of active disease. There seems more prospect of benefit from using these measures simultaneously than separately. In puncture of the skull a point must be selected away from the middle line, in order to avoid the sinus, and away from any large vein. A very fine trocar should be used, and only a very small quantity (say two ounces) of fluid withdrawn, careful compression of both sides of the skull being maintained meanwhile. If convulsions come on, the instrument should be at once withdrawn. A cap should be in readiness, made of sheet-caoutchouc, perforated with small round holes, to avoid heat of the head, and while unstretched slightly too small for the head ; and this should be applied directly on the withdrawal of the canula. If the child's condition is improved, or not made worse, by the first puncture, it can be repeated in a few days, but not in the same place. The operation, however, is often followed by convulsions; and it has seemed to hasten death. Still the disease itself is so miserable and fatal, that anything which holds out a prospect of relief, and does not entail suffering, may be tried. I have sometimes contemplated the possibility of injecting iodine in this disease, but have not hitherto met with a case in which I could think the attempt justifiable.

Almost every case of chronic hydrocephalus proves fatal, if the effusion is so extensive as to cause obvious increase in the size of the skull. At the same time, a few patients survive to maturity, as the man (Cardinal) whose bust is in most pathological museums, and who lived to the age of 29; and in a few cases the affection disappears by spontaneous cure. In some cases, where, without obvious malformation, there is some defect of intellect or temper, the only post-mortem appearance has been internal hydrocephalus to a slight amount. Such was the case in the body of a youth, otherwise well formed and healthy, who was beaten to death by his schoolmaster a few years ago. The brain was well formed; but the ventricles large, slightly compressing the convolutions, and containing a large quantity of limpid serum.

A case was related to the Royal Medical and Chirurgical Society, by Dr. Thompson of Newcastle-on-Tyne, in which a collection of fluid formed after a contusion received by an infant two weeks old, and gradually produced all the symptoms of external hydrocephalus. The head was twice punctured. At the first operation, clear watery fluid was drawn off, and continued to ooze from the puncture for some time. Convulsions occurred ten days after the operation, attributed to the cutting of some teeth. Another puncture, five weeks after the former, proved permanently successful: the fluid drawn off was more milky. Neither specimen seems to have been analysed.†

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* This point was elaborated by Mr. Prescott Hewett in his lectures at the Royal College of Surgeons.

† *Med. Chir. Proc.* June 28, 1864.

The Face.

The regional surgery of the face demands but little consideration in this place, since the greater number of its affections have been spoken of in other parts of the work. Thus the operations for remedying the deformities which are so frequent in this part will be found treated of under the head of PLASTIC SURGERY; salivary fistula under INJURIES OF THE FACE; and all the various affections of the MOUTH, JAWS, and GUMS under those headings. The tumours situated in the cheek and parotid region, however, have not been elsewhere described; and as they are of frequent occurrence, and of much surgical interest, we must devote a little space to this topic.

Tumours.—The most frequent tumour in the cheek is the common sebaceous cyst, which in male subjects is developed in front of the ear (i.e. in the hairy part of the face), only a little less often than it is found in the hairy scalp. Its diagnosis is obvious, and its treatment easy; but when it dips down more deeply than usual, and lies near Steno's duct, care must be taken, in dissecting it out, to keep close to the cyst. These cysts can in this region be removed most readily by slitting them across with the skin; and this plan also involves a more limited incision, which is an important consideration here. The incision should be horizontal, and the knife be kept as much as possible in the horizontal direction, in order not to wound the duct or nerve.

Cysts of other kinds are also occasionally seen.* I have treated one in the substance of the cheek, in a child five years of age, attributed to a blow received in very early infancy, and containing fluid exactly resembling blood. Iodine injection was practised, and I believe successfully; but the patient was lost sight of before the event of the case could be positively affirmed. I have also seen watery cysts in the neighbourhood of the parotid gland; but the most frequent tumour in this part is the *glandular parotid tumour.* This is a firm hard lump, situated generally below and behind the lobe of the ear, but sometimes in front of it, and is probably developed in one of the absorbent glands which lie over the parotid in that situation;† or it is supposed by some authors to be occasionally developed in the fibrous envelope of the gland. It bears a striking analogy to those glandular (adenoid) tumours which lie in the neighbourhood of other glands, such as the mammary and the prostate, and is described by a recent French author as a hypertrophy of the parotid.‡ It grows slowly, displacing the parotid gland, pressing more or less on the parts contained in that gland, and sometimes burying itself deeply behind the ramus of the jaw. Its structure is very firm and solid, consisting usually of well-formed fibrous tissue, mixed with glandular elements, in which portions of cartilage are often found; and it frequently has one or more cysts in its interior. Its continued growth produces deformity, frequently loss of hearing or difficulty of mastication, and more rarely palsy of the features on the affected side; and so its removal is very desirable. But the operation is often attended with unpleasant, and sometimes even dangerous, consequences, from lesion of the large vessels and of the facial nerve; therefore some caution should be exercised, both in giving an opinion on the probable result of the case, and in operating on the tumour. As with tumours in the neck, the main element of safety in these operations is to have a very free access to the surface of the tumour in some position where it can be approached safely, which in the parotid tumour will be at its posterior edge. For this purpose a ⊢-shaped incision will be most convenient, the vertical line passing down the posterior edge of the tumour. The growth will generally be found enclosed in a distinct capsule ; and if the latter be freely opened, and the knife kept close upon and directed towards the surface of the tumour, the operation is usually completed without accident.* But the position of the facial nerve, the external carotid artery, and the large trunk which forms the commencement of the external jugular vein, must be carefully kept in mind. I have often seen each of these parts wounded; and, indeed, it may be mechanically impossible to remove the tumour without dividing the nerve. If the artery is wounded, this happens generally in the last stage of the dissection, and there is frequently no difficulty in securing it. When the tumour passes into the neck, its removal is of course more hazardous; as also when it dips under the ramus of the lower jaw. If the trunk or a main branch of the facial nerve has been severed, a most unpleasant drawing of the features is the immediate result; and this condition is very likely to remain permanently. It is true that simple wounds of nerves rapidly heal, and often without loss of function ; but the division of a nerve in the cavity of a large wound, where the cut ends may not be in contact, or may become separated afterwards by inflammatory products, is another matter.† However, palsy of the nerve may be produced by inflammation occurring in its neighbourhood, without any wound, or with only a slight injury to the nerve itself; and this palsy will be transient. The circumstance will be distinguished by the fact of the palsy not occurring instantaneously after the operation, and being at first incomplete. If the tumour should extend far forward, Steno's duct is endangered, and may be divided, leading to a salivary fistula, which, however, if treated in the usual way, may prove curable.‡

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* Short references to several cases of cysts of various kinds situated in the face may be found in Jamain, *Manuel de Pathologie et de Clinique chir.* vol. ii. p. 42. Care must be taken to distinguish between a watery cyst and a collection of fluid in the expanded duct of the parotid from wound or obstruction of that duct. Cases of this latter affection will be found described by Jarjavay, *Mém. de la Soc. de Chir.* vol. iii. p. 492. It will be recognised by the position of the swelling, its increase in volume during mastication (when possibly some slight escape of saliva may take place through minute openings on the skin of the cheek), and the dryness of that side of the mouth. The treatment consists in re-establishing the opening into the mouth.

† See the figure by Mascagni of the lymphatic system of the face, reproduced in Gray's *Anatomy*, 5th ed. p. 445.

‡ Bauchet, in *Mém. de la Soc. de Chir.* v. 289.

These tumours are sometimes observed to recur, and in all probability this is usually in consequence of a portion having been left behind at the former operation; but the recurrence of adenoid tumours in other parts § should make us hesitate to admit that this is the only cause. The most interesting case is the one recorded by Langenbeck.‖ Here the original tumour was clearly distinguished, by its difference of appearance, from the substance of the gland in which it was imbedded. After a year it recurred. The extirpation was then difficult, and involved a wound of the facial nerve, and persistent facial paralysis. Five years afterwards the patient presented himself with a tumour beneath the sterno-mastoid, as large as a child's head, which adhered to the periosteum of the inside of the jaw, passed down on to the styloid process, rested on the sheath of the common carotid artery, and had the internal jugular vein imbedded in it. The extirpation of this tumour was nevertheless successfully effected, and even without injury to the vein.

The other tumours of the face derive too few peculiar characters from their anatomical relations to detain us at present. I would, however, just mention a very singular tumour, spoken of by MM. Bérard and Denonvilliers

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* A case related by Vanzetti, Observation de tumeur fibreuse de la parotide, *Bull. de la Soc. anat. de Paris*, 1844. p. 40, in which the tumour was of very large size, and passed inside of the ramus of the jaw, will show the importance of recognising and keeping within this capsule. When this is done, large portions can be detached without any cutting; and the capsule is sure to separate the operator from any important structure which may be endangered. See also Liston, *Prac. Surg.* 4th ed. p. 324.

† In a case related by Bauchet, op. cit. p. 337, the operator, M. Lenoir, having recognised the two ends of the facial nerve, which he had divided, placed them in contact, and the paralysis was only transient.

‡ Salivary fistula occurred in 3, and facial paralysis in 3, out of 11 such operations related by M. Bauchet.

§ See Diseases of the Breast, p. 260.

‖ *Archiv f. klin. Chirurgie*, i. 4.

(*Compend. de Chir.* iii. 99), formed apparently by a distension of the frontal sinus, producing intense pain, displacement of the eye, and a large accumulation of gas in the superficial parts of the face communicating with the neck. The patient was under the care of M. Jarjavay, and recovered after the tumour had been laid open and had suppurated.

Finally, I ought perhaps to say a few words about those great tumours which sometimes spring from the bones of the face, and produce horrible deformity by driving the eyes out, distorting the features, &c. They have been alluded to in the essay on DISEASES OF THE MOUTH, vol. iv. p. 467, as 'hypertrophies of the upper jaw-bones,' the name by which Mr. Stanley described them. Some of them are of this nature; others are diffused enchondromata, springing from the base of the skull. In a very remarkable specimen, in St. George's Hospital Museum, described and figured by the writer in *Path. Soc. Trans.* vol. x. p. 250, the tumour almost fills the anterior fossa of the base of the skull, and has pushed both eyeballs completely out of the orbits, besides filling the nasal cavity and projecting on the cheeks. When such tumours have been less extensive, and free from cerebral symptoms, attempts have been made to remove them; * but these have failed, in consequence of the extent of attachment of the tumour to the base of the skull. Very careful examination is therefore necessary before the surgeon commits himself to any such attempt; and it is only when there is sufficient reason for believing that the tumour has a comparatively narrow attachment, that the attempt holds out much encouragement. If the eyes are widely separated, and pretty equidistant from the middle line; if the parts of the tumour within reach are fixed to the bones of the face; and if ossification or calcification seems to be proceeding extensively in the mass,—the obstacles to the operation will probably be found insuperable; nevertheless, it is quite possible that the removal of the cartilaginous surface of the tumour may at any rate arrest its growth; and in these frightful cases it is justifiable to run considerable risks. The absence of dilatation of the face from outward pressure of the malar or superior maxillary bones is a favourable diagnostic indication, as tending to show that the nasal cavities are alone implicated. But even then the base of the tumour may be so extensive or so remote that its complete removal is impossible.

The *opening of the mouth* is occasionally much narrowed and displaced. This occurs as a consequence of ulcerative and gangrenous affections of the soft parts, and sometimes also of the bones; from lupus, rodent or cancroid ulcer of the face, mercurial ulceration, cancrum oris, burns, or wounds which have taken on an unhealthy action. The deformity is excessive; nutrition is sometimes seriously impaired from the limitation of the movements of the jaw, as well as the narrowing of the opening of the mouth; and an attempt at cure is imperative. In all such cases much care ought to be taken to ascertain, if possible, the condition of the parts inside the mouth. Sometimes the gums and cheek are incorporated, or the jaws may be partially ankylosed. Frequently large masses of foul deposit exist around the teeth. If the parts within the mouth are very firmly adherent, and the mucous membrane greatly altered from its natural condition and cicatrised, there is not much hope of success from surgical operation; but if the mucous membrane be movable on the skin, an incision may be made outwards from the corner of the opening, a portion of the skin may be removed, leaving the mucous membrane, which is then to be divided, and the mucous flaps stitched to the edges of the skin. In this manner, if primary union be obtained, there is the less risk of the opening recontracting. Or, if this be impossible, two flaps of skin may be drawn down from the face and united to the edges of the incision, with their cutaneous surfaces towards each other. If these will unite kindly to the raw surfaces left by the incision, the re-adhesion of the edges of the wound, and its consequent cicatrisation, with reproduction of the deformity, may possibly be obviated. But it must be allowed that the parts are often so diseased and scarred, both around the opening and for a long distance on the cheek, that neither of these plans is feasible. In the only case in which I have had an opportunity of trying this proceeding,* the substance around the oral opening was so completely altered in character, that it was impossible to separate mucous membrane from skin; while the parts on the cheek and chin were so changed from their natural condition, that it would have been hopeless to endeavour to transplant skin. Under such circumstances, as also when the parts inside are extensively cicatrised, it would be well to give a patient trial to dilatation by means of conical pads of ivory, compressed box-wood, or some similar smooth substance, so contrived as to make gradually increasing pressure against the opening.†

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* Viz. once by Mr. Morgan of Guy's Hospital, and again by Mr. Moore; the model of the head in the former case is in the Museum of Guy's Hospital.

Inflammatory affections about the parotid or other salivary glands are of very frequent occurence; especially the trivial contagious affection so common in children called the mumps, which consists in swelling of and around the parotid, submaxillary, and sublingual glands, accompanied with some pain and stiffness in using the jaw. It is ordinarily confined to one side at first; but is very liable to spread to the other. Generally it is quite devoid of danger, or, in fact, of any importance, and requires no treatment beyond a warm fomentation or poultice, with perhaps some saline diaphoretic. But cases in which the inflammation has been transferred (by metastasis, as the term is) to the testicle have been already referred to (p. 108); and the same thing takes place in the female mamma, though more rarely; while metastatis to the brain appears to have been noticed. These complications must be treated in the same way as similar inflammations excited by other causes.

Inflammation of these parts may also be excited by the use of sialogogue medicines, especially mercury; or inflammation accompanied by salivation may occur spontaneously. In the former case the disuse of the irritant, with the frequent employment of astringent gargles, and the internal administration of tonics with chlorate of potash and nutritious fluid diet, are the measures indicated. Spontaneous inflammation of the salivary glands is generally more rebellious to treatment: the general health and the local condition of the gums should be the first objects of enquiry and attention. If there be much swelling and tenderness about the parotid, leeches may be of service. When the inflammation has become chronic, the local application of iodine, or the careful use of mercurial ointments, is indicated.

These complaints are all of them liable to end in abscess; and such abscesses, bound down by the firm fascia which covers the parotid gland, are both painful in themselves and distressing, from the impediment they offer to mastication. They have been also known to burst into the meatus auditorius, and to burrow about to a great extent in the neck. They should be opened early; but it is desirable, in all affections of the face and its neighbourhood, to avoid too free incisions; and if the opening be made sufficiently early, a mere puncture through the skin, with a tolerably free division of the subcutaneous parts, including the fascia, will suffice. If a more extensive incision be required, the natural foldings of the skin must be studied, and its direction be made to correspond.

Abscesses are occasionally produced by calculi imbedded in the duct of the parotid gland. The existence of such calculi in some cases of ranula has been already noticed, vol. iv. p. 224 Their composition is phosphate of lime, with a little triple phosphate. If such an abscess be allowed to burst externally or be opened on the cheek, a salivary fistula will probably result. Hence it is important to open the abscess and remove the foreign body (which can easily be felt) from the interior of the mouth.

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* The case was reported by Mr. Sercombe, in the *Med.-Chir. Trans.* vol. xxxix. p. 95.

† See the essay on Injuries of the Face, vol. ii. p. 425. On this subject consult Wernher, *Handbuch der allgemeinen Chirurgie*, vol. iv. p. 18.

The face is liable to be attacked by epithelial, rodent, and lupous ulceration. The nature of these various forms of disease has been discussed in other essays, and their diagnosis and treatment has been, as far as possible, pointed out. But the interesting question remains for discussion in this place, what resources has operative surgery in the treatment of these affections when they attack the face? Few surgeons of experience can have been without opportunities of witnessing the frightful condition which is induced by cancroid and rodent ulceration of the face. The features gradually and slowly yield to the progress of the disease; the soft parts are eaten away; the bones crumble, or become necrosed; the nose and mouth, and sometimes the orbit also, fall into one cavity, and yet the patient lives on, though frequently suffering terrible pain; and although presenting a condition of incurable mutilation, which no feelings of humanity can prevent our regarding with some amount of repugnance. The disease is too generally regarded as a hopeless one, and the surgeon is glad to escape from his patient. Yet, in the case of rodent ulcer almost certainly, and in many of the cases regarded as epithelioma very probably, if the disease were destroyed entirely and in its whole extent, the patient would be restored to good general health, the edges would cicatrise, and the gap in his features could be filled up by some of the many kinds of mask, or false features, which the ingenuity of our dentists and mechanicians has produced.* Much encouragement for boldness in operating on such cases when occurring in the face may be drawn from the treatise of the late Mr. Moore on *Rodent Cancer*, where some striking instances of the success of the treatment are detailed. I may be allowed to cite the following passage (p. 52):—'The knife and caustic may be so combined that the surgeon shall extirpate the disease in a very advanced stage, protecting the patient absolutely from pain and shock by the use of chloroform, and the subcutaneous injection of morphia, and supplying by a suitable mask the shrunken gap which is left after the cicatrisation of the wound. I first found how far such an operation could be carried in the case of Mary H., in which I removed all the margin and contents of the right orbit, with the bridge of the nose, and laid a paste of the chloride of zinc on the freshly-cut surface, which still presented fragments of the disease in the exposed portions of the bones. Before the patient awoke from the effects of the chloroform, I injected morphia beneath the skin, and under its influence she remained asleep for six hours, and awoke free from pain. In five weeks the inodorous slough came away, the wound healed, and the patient lived three years in comfort, wearing a vulcanite mask, which was skilfully moulded and painted to represent the defective features. Another patient who was under the care of Mr. De Morgan, after as extensive an operation, completely recovered, and afterwards not unfrequently enjoyed a day's shooting. . . . The advantage of this method of treating rodent cancer appears to consist in the completeness of the caustic action of the chloride of zinc. There is no expenditure of it upon the dense margin of the disease, but it acts directly upon the soft tissues which are exposed by the incisions. These apparently healthy, but really morbid parts, are readily permeable by the caustic, and they can be destroyed to any depth which may be deemed requisite.'

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* Much freedom in operating on these cases of epithelial ulceration is justifiable, in order to relieve the wearing pain which it occasions, even if for no other motive. A man above eighty years of age came under my care some years ago, begging for relief from the pain of an extensive epithelial ulcer of the eyelids. He was labouring under disease of the heart, and could not safely be brought under the influence of chloroform, but he had great courage, and submitted to the operation without complaint. I removed the whole of the lower and about half of the upper eyelid, down to the bone, and filled up the gap with a flap from the cheek. This united perfectly. He was freed from his distress, and no return of the disease took place up to the time of his death, which occurred from the heart-disease, in his sleep, about half a year after the operation.

The Neck.

The chief points in the surgical anatomy of the neck are connected with the arrangement of the cervical fascia. This membrane has an arrangement in the neck somewhat similar to that which prevails in the limbs, although more complicated; that is to say, it consists of a system of long sheaths or tubes, which surround the muscles and the chief vessels, together with the trachea, and which take attachment to the bony framework of the part—viz. to the lower jaw above, the clavicle and ribs below, and the spinal column at the back. As the fascia lata, if traced upwards, will be found continuous with the iliac fascia around the femoral vessels, so the cervical fascia may be traced behind the sternum and ribs, till it becomes continuous with the outer layer of the pericardium. Now, the extensive connections of this fascia explain how it is that tumours, lying beneath it in the neck, may grow to such a size, may pass down in so many different directions, and may implicate such important parts before they have made enough progress externally to induce the patient to apply for their removal; how spreading affections, such as diffuse inflammation or abscess, may pass down into the cellular tissue of the thorax, and the disease thus be withdrawn from all possibility of successful treatment; and therefore why surgeons always regard operations conducted below the cervical fascia with apprehension, both on account of their immediate dangers, and their possible complications.

The affections which attack the parts superficial to the cervical fascia do not call for much notice here. Sometimes, however, superficial tumours may be met with in this situation, which, either by the negligence of the patient, or the ignorance of those whom he has consulted, have been allowed to grow to a great size. A striking instance of this is the fatty tumour figured in Liston's *Practical Surgery* (4th ed. p. 321), and which was as large as the patient's head.* When above the fascia, these growths, whatever be their size, may be removed with as little risk as tumours of the same size in any other parts. The signs indicative of their being situated over the fascia, will be the readiness with which the finger can be inserted beneath them and then passed between their base and the larynx, or the sterno-mastoid muscle, their mobility and the dimpling of the skin when moved over them, which is usually noticed in fatty tumours.

We pass on to consider that peculiar form of watery cyst which is described as *hydrocele of the neck.* This tumour is sometimes superficial to the cervical fascia, but usually more deeply seated; sometimes congenital, at others an affection of later life;† sometimes simply cystic, at others of a more complex anatomy. The first point to be established is the character of the tumour, and the next its situation. Simple watery cysts, or true hydroceles, are such as are destitute of all solid base, and contain frequently a purely watery fluid; at other times, more or less of the constituents of the blood may be found mixed with the fluid (hæmatocele). The cyst is usually single. From this type there are numerous variations: thus, the occurrence of a congenital tumour, consisting of one or two cysts, with a solid basis, is sufficiently common; and the number of the cysts, as well as the quantity of solid matter, may be increased until the whole side of the neck is filled with a solid tumour, in which cysts with various contents are scattered. This latter affection is, I believe, always congenital.‡

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* See also a case in *Path. Soc. Trans.* vol. xi. p. 256.

† Gurlt, *Ueber die Cystengeschwülste des Halses*, p. 210, says that very few of the recorded cases have been congenital.

‡ See, on the subject of these compound cystic tumours of the neck, a paper by Mr. Cæsar Hawkins in *Med.-Chir. Trans.* vol. xxii.; one by the author 'On congenital

The neck is undoubtedly the favourite situation for congenital tumours, and those which occur congenitally in this region are almost always of the polycystic variety. The question of chief importance in their diagnosis and treatment refers to the proportions of solid substance which they contain. They usually extend deeply into the part, passing underneath the cervical fascia into the loose cellular tissue supporting the carotid sheath, the trachea, and œsophagus, and very often will be found to have completely surrounded one or more of these structures. I have seen cases in which the morbid growth had affected the structure of the tongue as well as the cellular tissue of the neck.

In the front of the neck these congenital tumours appear always to originate in the loose cellular tissue beneath the cervical fascia, and to make their way through that membrane and beneath the skin simply by pressure. I have never seen a case in the front of the neck which did not bear out Mr. T. Smith's assertion,[*] that congenital cystic tumours are always situated beneath the muscular fascia, although many of them have a subcutaneous portion.

The carotid triangle is a favourite situation for these tumours. In one instance under my care, the solid portion of the tumour contained such numerous and variously shaped cells as to raise a suspicion of malignancy.

The diagnosis of the affection has been obvious in all the cases which I have seen.[†] The only ambiguity which I have met with is, as to whether hardening around the base of a cyst depended on the presence of a solid tumour, or was due merely to the pressure of the cyst. The doubt would much influence our prognosis, though perhaps it would not make any difference in the treatment adopted at the commencement. I ought also to mention that Von Ammon[‡] describes and figures tumours, apparently of this compound cystic nature, as congenital enlargements of the thyroid body. I have not seen any which were developed in that organ. The diagnosis would be easily made by watching the effort of swallowing on the position of the tumour, and by tracing, if possible, the muscles connected with the thyroid cartilage and under border of the hyoid bone.

As to the prognosis and treatment of these cases. The simple hydroceles advance somewhat rapidly; they may grow, however, to a large size without making pressure on the deep-seated organs, and treatment may be adopted with much prospect of success.[§] I have seen in an instance of simple hydrocele a single injection of tincture of iodine followed by complete cure, although the cyst was of large size. The patient was an infant, under Mr. Prescott Hewett's care, and on examining the parts afterwards nothing was to be felt but the hardened remains of the cyst, while the distended skin hung in a loose fold over the clavicle. In other cases, even when some thickening existed at the base of the cyst, I have seen iodine as completely, though less rapidly, successful. But where there is solid matter as well as cysts iodine injection does not usually succeed, and then it may be justifiable to resort to setons, though

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Tumours,' *Lancet*, May 21 and 28, 1864; and see also the section on congenital tumours in the essay on the SURGERY OF CHILDHOOD, p. 834.

[*] In his paper in *St. Bartholomew's Hospital Reports*, vol. ii.

[†] M. Michaux (*Bull. de l'Acad. Roy. de Méd. de Belgique*, vol. xii., and *Gaz. des Hôp.* No. 36, 1853, pp. 136, 144, 147) relates several cases of hæmatocele of the neck, in some of which the diagnosis was so obscure that nothing but puncture would clear up the difficulty. In most cases the diagnosis from aneurism may easily be made, even if the tumour should have the arterial pulsation, by remarking that though pressure on the carotid below suspends the pulsation of the tumour, it leaves it equally full, tense, and distinctly fluctuating, as also by studying the bruit. See a case reported by Gurlt, op. cit. p. 225.

[‡] *Die angebornen chirurgischen Krankheiten*, tab. xiii. figs. 1, 2, 3; tab. xxiii. figs. 7 to 11 incl.

[§] A case is reported by Wernher (*Die angebornen Cysten-Hygrome*, Giessen, 1843, p. 3), where openings formed spontaneously in the tumour, the fluid oozed away, and a natural cure resulted. Another is recorded by Mr. B. Phillips, *Med.-Chir. Trans.* vol. xxv. p. 299.

the measure is not without danger,* or to make a free incision into the cyst or cysts, and endeavour to procure their obliteration by the granulating process, or to cut a large piece of the cyst out, or even to destroy the whole mass by the application of arrows of caustic, as recommended by Maisonneuve (see MINOR SURGERY, p. 550). But in cases which are suitable for removal, extirpation, though of course it presents more immediate risks, seems ultimately the less dangerous course. On this subject the reader is referred to what is said below on the general question of removing tumours of the neck.†

Deep sebaceous cysts.—The nature of the tumours which are so often found in the deeper parts of the neck, that is to say, lying in or below the deep cervical fascia, is a matter of great importance in their surgical treatment. Langenbeck‡ has pointed out that dermoid cysts in this region, contrary to what takes place in other parts of the body, are frequently found below the deep fascia, and not unfrequently adhere to the sheath of the cervical vessels, or are possibly developed in the substance of the sheath.§ As to diagnosis from cysts of a different kind, Langenbeck points out that in all the recorded instances these deep sebaceous cysts have been situated in the neighbourhood of the larynx, or of the great vessels of the neck, above the omohyoid muscle; that in the latter situation they are perceptible from the mouth, and the peculiar fluctuation of the pulpy fluid they contain may be felt by placing one finger in the mouth and another on the skin; that the swelling is of a round or oval form, and perfectly smooth; that they may often be made to share the pulsation of the carotid by drawing the head strongly backwards and to the opposite side; and that they are, sometimes at any rate, movable from side to side, but not upwards and downwards. It must, however, be allowed that these signs are hardly sufficient to distinguish them from other cysts in all cases without a puncture. After having tried all the usual plans of treatment, and after having succeeded in curing one of these tumours by maintaining suppuration in it for a year and a half, Langenbeck has found such measures so uncertain and so tedious that he prefers extirpation with all its risks.

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* Thus, in Dr. Storch's case (*Journ. f. Kinderkrankheiten*, vol. xxxvii.), the seton was used with a fatal result. The dangers of setons in cases of cysts of the thyroid body are well known. They are perhaps less dangerous in other deep-seated tumours of the neck; but they should never be used without grave deliberation. I have seen the use of a seton in a case of this sort fatal in a week to a person otherwise in good health.

† It was in all probability to such tumours as these that Mr. Liston refers in the following passage: 'In the lower triangular space of the neck, though not so frequently as in the upper one, all sorts of strange tumours are encountered. Many watery tumours are met with here, some of them in young patients, and congenital; others appearing at a later period. The smaller ones may be opened and dressed from the bottom, or treated with escharotics. Some of them may be punctured and treated by seton; others have besides a mass of solid material attached, and then extirpation, if practicable, is to be preferred. A curious case occurred in my hospital practice lately: a middle-aged healthy man applied on account of a soft elastic lobulated mass, filling completely the space above the right clavicle. It was taken to be a fatty tumour, and was cut upon accordingly. The first incision gave vent to an ounce or more of serum. The dissection was pursued, and six or eight other distinct sacs adherent to each other were gradually exposed and extracted. The space of the neck was completely laid bare, the nerves could be seen, and the subclavian artery pulsated at the bottom of the wound. The internal jugular vein, for two inches, was exposed; and, for the first time, I was cognisant of air rushing into a branch entering into the root of this vessel. So complete was the exposure of parts that the carotid and subclavian arteries could have been tied without further dissection. All went well.' Liston, *Practical Surgery*, 4th ed. p. 330.

‡ *Archiv f. klin. Chir.* vol. i. part 1, *Beiträge zur chirurgischen Pathologie der Venen*, one of the most interesting and important treatises in the whole range of surgical literature.

§ The published instances of this disease before the date of Langenbeck's paper will be found in Gurlt, op. cit. chap. vi. cases 3, 5, 6, pp. 266, 267.

The most ordinary of all surgical affections of the neck is the *enlargement of the glands*, which is so very common in scrofulous persons, especially children. On this head reference is to be made to Mr. Moore's essay on DISEASES OF THE ABSORBENT SYSTEM, vol. iii. p. 340; and to Mr. Savory's on SCROFULA, vol. i. p. 367. But I would here call attention to a point of some practical importance, noticed by Prof. Miller.* He points out that scrofulous enlargement of these glands 'must be carefully distinguished from the syphilitic glandular affection, characterised by implication of the whole chain of lymphatics on both sides of the neck, along the anterior margin of the trapezius . . . . The glands affected [with syphilitic disease] are painless, about the size of hazel-nuts, indurated, and never suppurate. They become affected in this manner before any eruptions make their appearance, and continue sometimes long after any other constitutional symptoms.' He regards this condition as almost pathognomonic of constitutional syphilis. He also describes another form of glandular enlargement usually on one side of the neck, of a stony hardness, and generally involving the whole lymphatic chain. The hardness closely resembles scirrhus, but has no real connection with the cancerous cachexia. It is due to anæmia, and is sometimes conjoined with exophthalmic goitre.

Other glandular affections in the neck are occasionally met with, though less commonly than the above. Thus, in the 16th vol. of the *Mémoires de l'Acad. Nat. de Médecine*, is a paper by Larrey, jun. on a form of glandular enlargement from chronic inflammation, which he has often met with among the younger soldiers of the French army, and which he refers neither to syphilis, scrofula, nor local irritation (unless it be excited in some cases by stomatitis, the result of the abuse of tobacco), but rather to the moral and material depressing causes incident to the change from the civil to military life.

A peculiar form of enlargement of the cervical glands is described by Dr. J. W. Ogle, in *Path. Soc. Trans.* vol. xi. p. 255, in which they formed a chain of large rounded tumours, which were successfully removed by operation. The nature of the affection remains obscure.

These glandular affections also may implicate the sheath of the great vessels of the neck. Thus in Larrey's case, mentioned below, p. 984, and in several of those referred to by Langenbeck, enlarged glands were found in the substance of the sheath itself; and on their removal, the carotid artery or the jugular vein, as the case might be, but more commonly the latter, was left cleanly dissected out, and quite deprived of all covering from its sheath. Langenbeck cautions his readers not to be deceived into relying too much on the mobility of such tumours as a certain mark of their superficial position, since this may really be only the movement of one part of the tumour on another, and the deeper parts of the mass may be lying on, or between, or even behind, the vessels. He does not on that account shrink from advising the removal of such tumours when other means fail: but it is plain how great the dangers and difficulties of the operation may prove. It should, therefore, never be performed unless the glands affected are limited in number, unless the symptoms of the disease are really productive of serious distress, and unless a very patient trial has been given to topical and general remedies; and the surgeon ought to enter on the operation with a full knowledge of the difficulties he may encounter, and the precautions which are to be taken to meet them.

Cancer also, whether of the epithelial or other forms, may affect the deep parts of the neck and implicate the sheath of the vessels. It may be known by its occurring later in life than the previously-named affections; by its less defined outline; the strings or processes which often project from it; the pain which it produces; its tendency to spread towards the pharynx and larynx, thus producing dysphagia and dyspnœa; by the more extensive interference with the circulation which it causes, and in advanced cases by the enlargement of the glands below the tumour. The innocent tumours previously described, though they may compress the vessels, do not infiltrate them; but with these cancerous tumours the vessels and nerves may be absolutely incorporated. If, therefore, they are to be operated on, it should not be without the most careful and repeated examination.

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* *System of Surgery*, 1864, p. 844.

The diagnosis of tumours at the root of the neck, in fact in all parts of the region, but particularly at the root, near the pleura, must be carefully made from the *abscesses* which are so frequent in this situation, and which have been spoken of in the essay on ABSCESS, vol. i. p. 124. Such abscesses do not fluctuate at first, in consequence of their deep position and their being bound down by the fascia; but they are seldom, if ever, found without some sign of inflammation, besides which the diseases on which they often depend will be present, and will materially assist diagnosis. These are scrofulous affections of the glands, disease of the vertebræ, inflammation of the pleura, and, it is said, disease of the arteries; other abscesses, however, having no visible exciting cause, are not uncommon. The rate of progress of the disease, its much more acute symptoms, and the ill-defined extent of the swelling, usually distinguish abscess from tumour. Hydatid cysts have also been found in this as in most other regions. Mr. Dixon's case is well known;* and others, both within the thyroid body and external to it, will be found in Gurlt's work. The proper treatment will be to lay open the cyst, take away all the hydatids, and allow the cavity to fill up by suppuration.

The *sterno-mastoid muscle* may be occasionally found indurated, and forming a sort of tumour, which extends up a great part or the whole of the neck. This affection has been already referred to in the essay on DISEASES OF MUSCLES, vol. iii. p. 627, and I only mention it here with reference to diagnosis. It is most common in children. Indeed Mr. Bryant, in his *Lectures on Surgical Diseases of Children* (p. 142), speaks of it as though it were peculiar to early life. I have seen cases in the out-patient room of the Hospital for Sick Children, in one at least of which I thought the affection was syphilitic; but in others no such taint has existed. It must be carefully distinguished from an enlargement formed by strumous glands, and there will be no difficulty in doing so, if the surgeon will bear in mind the existence of the affection. The obvious test is that the swelling in one case is within the sterno-mastoid, and its mobility varies with the contracted and relaxed state of the muscle; while in the other case the swelling is behind the sterno-mastoid, and is unaffected by its action. The muscular affection is a very curable one in childhood, and very often perhaps would disappear spontaneously; if not, heat or gentle counter-irritation, with attention to the general health, will cure it; while the glandular affection, unless owning a well-marked local cause, is a very rebellious one, and may prove quite incurable.

Enlarged bursæ are found in the anterior part of the neck, although rarely. At least the cases of this disease which are on record are few; but this, as Gurlt observes,† may proceed from the triviality of the affection as probably as from its rarity. These bursæ may be situated either in front of the pomum Adami, between the posterior surface of the hyoid bone and the thyroid cartilage, or between the muscles of the tongue. The two former bursæ are found in the normal state, although that in front of the thyroid cartilage does not always exist. The bursa among the muscles of the tongue is an accidental formation, and has been spoken of in the essay on DISEASES OF THE TONGUE (vol. iv. p. 224). The first kind (the ante-thyroid bursa) forms a rounded fluctuating superficial swelling in front of the larynx in the middle line, reaching downwards towards, and in a case recorded by Larrey ‡ even prolonged to, the sternum by a fistulous channel. The second (the supra-thyroid bursa) is of smaller size, and lies on one side of the middle line, covered by the thyro-hyoid muscle. Both of course follow the larynx in its movements during deglutition, and so far resemble the cysts of the thyroid body; from which, however, there can be but little practical difficulty in distinguishing them. If there be any doubt about the diagnosis, the character of the fluid evacuated by puncture will settle the point. Instead of the disintegrated remains of blood which are found in the thyroid cysts, these contain the jelly-like fluid which characterises bursal tumours and ganglions in other parts of the body. The treatment should be the same, viz. puncture and blisters, or injection of iodine.

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* *Med.-Chir. Trans.* vol. xxxiv.

† Op. cit. p. 39. A complete collection of the recorded cases of each variety of bursal tumour may be found here.

‡ *Gaz. des Hôp.* 1853, pp. 212, 225.

A curious and rare affection in the neck is the *congenital fistula*, originally described by Dzondi and Ascherson,* and of which I have given an account in another work.† I need merely say here that these fistulæ communicate often with the trachea, and in some there has been reason to believe that a communication existed with the pharynx, that they form one or more minute openings; sometimes in the middle line, at others on both sides and at the same level, or again on one side only (generally the right): their position varying from the level of the notch which marks the upper border of the thyroid cartilage down to the neighbourhood of the sterno-clavicular joint. The only case I have seen was amenable to a very simple plastic operation, but here no communication with the trachea or pharynx could be traced. The inconvenience caused by the fistula is so slight that I should not recommend any more radical proceeding. The origin of these fistulæ is referred by Ascherson to the persistence of portions of three fissures which were discovered by Rathke to exist in the neck of the human embryo and those of other warm-blooded animals at an early period of development, analogous to the branchiæ of fishes, and coinciding in the time of their appearance with an arrangement of vessels similar to what exists in fishes.

Removal of tumours of the neck.—Tumours lying below the deep fascia of the neck are always the source of anxiety, and often of great embarrassment, in their removal; and this becomes more and more the case as the tumour passes further forward. When the mass lies beneath the sterno-mastoid muscle, the surgeon must always consider carefully, before he commences the operation, whether he is likely to be able to bring it to a termination—that is to say, whether he has a fair prospect of removing the whole growth; for unless such a prospect exists, the operation is unjustifiable. The main points in these operations are so well detailed in an account by Mr. Spence of the removal of an enormous enchondroma from the neck and face, that I cannot do better than refer the reader to his most interesting paper in the *Dublin Quarterly Journal of Medical Science*, Nov. 1863. The operation was, as far as I know, unique at the time, the tumour extending from the zygoma nearly to the clavicle, and from the spine to the cricoid cartilage, and weighing more than 7 lb. In summing up the chief points of this very remarkable case, Mr. Spence dwells upon the following as the main considerations to decide the practicability of removing a tumour from beneath the sterno-mastoid muscle: 1. Is the growth innocent or malignant? If malignant, the important structures near which it lies will very probably be incorporated with it, and the tumour could perhaps only be removed by doing fatal damage to them: if innocent, however closely it may press on these structures, it will be enclosed in its own capsule; and by keeping the edge of the knife or scissors close upon the tumour, the main vessels and nerves will in all probability be avoided. 2. The state of the circulation: engorgement of the veins on either side,‡ or marked alteration of the arterial supply in the affected side, would give reason to fear that the growth is extensively connected with the internal jugular vein or the carotid artery respectively. And finally, the impairment of the functions of respiration or deglutition, or the existence of laryngeal irritation, would point to implication of the vagus nerve, the phrenic or the laryngeal nerves, or to pressure on the œsophagus or air-tube. Careful exploration from the mouth, and an examination of the mobility of the tumour in various positions of the head, should not be neglected.

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* Translated in Dr. Day's *Obstetric Records*, vol. i.

† *Surgical Treatment of Children's Diseases*, 2nd ed. p. 138.

‡ Langenbeck points out that in tumours which involve the sheath of the vessels engorgement of the veins of the face is rarely absent. In one case he observed this

In the operation for removing such tumours, the main points are to have a very free access to the tumour, and for this purpose to dissect large flaps off it by crucial incisions, to define its surface clearly and for a large extent in some position where its relations are free from danger (usually its posterior border), and to work gradually from this point by stretching the tumour so as to make plain its cellular connections, and then cautiously dividing the latter with the scalpel or blunt-pointed scissors directed *towards* the tumour.* In Mr. Spence's case the extent of the growth was so great that the whole sterno-mastoid was of necessity divided; and then the plan which Mr. Spence adopted, of exposing the whole front of the tumour and cutting across the muscle at once, is no doubt the best, since it gives as full a view as possible of the whole neck, and enables the assistant (whose duties in these operations are almost as important as those of the operator) to compress the main vessels and to push them back, by insinuating his fingers in the track of the dissector. But in the case of a tumour situated beneath the sterno-mastoid of much less extent than in Mr. Spence's patient, although still of considerable size (since the dissection commenced above, over the mastoid process, and terminated below by exposing a part of the brachial plexus, and was continued backwards to the transverse processes of the cervical vertebræ), I was able to remove the tumour without cutting through the whole sterno-mastoid;† and I believe that it is better to retain the sternal portion of the muscle entire, if possible, whenever the growth does not project beyond its anterior edge. This proceeding is more dangerous than that adopted by Mr. Spence, since the part of the growth lying near the carotid sheath has to be dug out, as it were, from beneath the muscle almost in the dark; but, on the other hand, the preservation of a part of the muscle is a safeguard against deformity. When the edge of the tumour has been fairly and cleanly exposed, the operator should next endeavour to clear its lower part, whenever there is a doubt as to its relations to the great vessels of the neck, in order to expose their sheath and render himself master of the circulation through them. Cases quoted below will show that both the common carotid artery and internal jugular vein may be tied without compromising the success of the operation; and even the division of the pneumo-gastric nerve also has been followed by recovery. But every possible effort should be made to remove the tumour without dividing any of these structures, particularly the last. The vein is the most likely to be implicated. Innocent tumours, even when they occupy the sheath of the artery, do not generally surround it. Langenbeck has shown that the jugular vein may be dissected out for some inches from the substance of a tumour, the vessel being entirely denuded and its whole sheath removed, yet no ill consequences follow.‡ If the descendens

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venous engorgement to be on the opposite side to the tumour. This he attributed to the fact that the tumour compressed the carotid artery as well as the jugular vein, as proved by the weakness of the pulse in the temporal artery.

* Dieffenbach (*Op. Chir.* vol. ii. pp. 327 et sqq.) recommends, in operations on large tumours, to use two separate incisions, both longitudinal, one running over the front of the tumour, more or less parallel to the anterior edge of the sterno-mastoid, the other behind that muscle. He used to dissect the tumour free from its spinal attachments from the posterior incision, and to free it from the vessels, &c. by dissecting from the anterior one. His main object seems to have been to avoid the division of the sterno-mastoid; but a sufficient number of cases are now on record to prove that even the entire section of this muscle does not do any material harm.

† *Lancet*, 1864, vol. i. p. 576.

‡ *Archiv f. klin. Chir.* i. 4, 14.

noni nerve be in the way, as in Gibson's case, it may be divided. In the more delicate part of the dissection blunt-pointed scissors should be used, and the fingers should be employed to sever the adhesions of the tumour as much as possible, and as a guide or director to the cutting instrument when the wound is too deep to allow of a clear sight of the parts. Compression of the internal jugular below the tumour will be a safeguard against death from the entrance of air into the heart.

Such operations as these appear to have been rarely undertaken,* Mr. Spence's researches having only discovered four published cases of the kind by British surgeons † previous to the publication of his own: but smaller tumours, mostly of an enchondromatous or solid fibrous nature, lying in the anterior triangle of the neck, or over the parotid gland, are very common, and the operations for their removal must be managed on the same general principles, viz. to open the capsule of the tumour (when it has one), expose its surface freely in some safe part, and then stretch and carefully sever the cellular adhesions of the other parts. In doing this the operator must take all possible precautions not to permit the entrance of air into the veins, and all large veins should be tied before they are cut.

Foreign surgeons have been somewhat more bold in their treatment of these formidable tumours. Langenbeck's brilliant operations have been referred to: and his paper should be studied by every surgeon entering on this department of operative practice. In connection with this question the reader may also be referred to the paper by Larrey in the 16th volume of the *Memoirs of the French Academy of Medicine*, in which the propriety and the method of performing these operations is discussed at length. M. Larrey regards such operations as being the most uniformly successful in the whole range of surgical practice, if only the risks of the operation itself are got over without disaster.‡ Several interesting cases are quoted; especially one in which his father, the first Baron Larrey, removed a mass of diseased glands from the anterior triangle, one of which was imbedded in the sheath of the vessels; and another case in which M. Labat successfully extirpated a tumour extending from the mastoid process to the clavicle, and lying altogether beneath the sterno-mastoid muscle, which was divided across in order to expose it. The carotid artery and internal jugular vein had to be tied, and the pneumo-gastric nerve divided.§

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* Some surgeons are indeed formally opposed to such endeavours. Thus Professor Miller says that 'tumours beneath the sterno-mastoid do not admit of operative interference.' *A System of Surgery*, 1864, p. 846.

† Mr. Atkinson of York relates, in the *Med. and Phys. Journ.* vol. xxx. p. 353, a case, the physiognomy of which, as given in the drawing, is something like that of Mr. Spence; but the account is obscure, and it is not said whether the tumour lay above or below the sterno-mastoid. This tumour weighed 3 lbs. 9 ozs., and the carotid artery and jugular vein were exposed in its removal. The operation was successful. Mr. George Bell has also put on record, in the *Journal of Medical Sciences* (Edinburgh, vol. i. 1826, p. 61), an operation for the removal of a tumour weighing about 4 lbs. 'from the muscular fascia of the neck.' This tumour lay above the sterno-mastoid, but dipped down, so that the common carotid artery was exposed in removing it. It stretched from the mastoid process to the clavicle, and seems to have been of a malignant nature, as it recurred a few months afterwards.

‡ Dieffenbach also says: 'Eine grosse Anzahl Operationen dieser Art, welche ich gemacht habe, sind in keinem einzigen Falle von einem tödtlichen Ausgange begleitet gewesen, und die Heilung erfolgte gewöhnlich ungemein rasch.' *Op. Chir.* ii. 322.

§ In Gibson's case (*Am. Jour. Med. Sc.* vol. xiii. p. 305) the tumour was successfully removed from beneath the sterno-mastoid after the carotid artery and jugular vein had been tied and divided. The descendens noni nerve was cut, but the pneumogastric was dissected out of the mass. The disease was malignant, and recurred; yet it was enveloped by a very firm and distinct capsule.

TABLE OF THE CHIEF FORMS OF TUMOUR IN THE NECK.

	Origin and Progress	Relations to neighbouring parts	Movements communicated from neighbouring parts	Fluctuation	Remarks
Abscess.	Recent origin. Quick progress.	Soon affecting the skin.	No.	Yes.	Known by the inflammatory œdema of the skin.
,, below the fascia	Do.	Rapidly producing great pressure on the pharnyx.	No.	Possibly not perceptible.	
Simple hydrocele	Sometimes congenital. Gradual growth.	Uusually superficial; in some cases displaces or laps round the sterno-mastoid.	No.	Yes.	May often be known by its complete transparency.
Compound cystic tumours.	Always congenital. Growth often rapid.	Spread variously, and often very extensively.	No.	In parts.	Fluid resembling blood, or variously blood-tinged, often evacuated on puncture.
Bursal tumours.	Remote origin and slow growth, generally.	Limited to the three situations pointed out on p. 981.	Moves with the larynx.	Yes.	A rare but very trivial affection; the diagnosis obvious in the few cases I have seen.
Simple sebaceous tumours.	Not congenital. Slow growth.	Superficial.	No.	Not usually, only when the fluid is thin and the cyst not tense.	
Deep sebaceous cysts	As above.	Lying in the carotid triangle, pressing on the great vessels, and perceptible from the mouth.	No.	Imperfect fluctuation may sometimes be felt from the mouth.	Can often be made to share the pulsation of the carotid in proper positions of the head (v. p. 979).
Glandular tumours	Connected with the development of other diseases. Growth variable; usually multiple.	Very various; generally forming a superficial chain down the neck.	No.	Only when suppurating.	Usually in strumous persons, with eruptions of the scalp, carious teeth, &c.; or (when affecting the posterior chain) in constitutional syphilis.

Continued overleaf.

TABLE *continued.*

	Origin and Progress	Relations to neighbouring parts	Movements communicated from neighbouring parts	Fluctuation	Remarks
Other innocent tumours.	Noncongenital. Growth usually slow.	Very variable; seldom make pressure on the deep structures, unless of long growth, and never infiltrate them.	No.	No.	They are known from enlarged glands by their solitariness and the absence of remote affections; from malignant tumours by their slow growth and by their limitation.
Cancerous tumours	Not congenital. Growth usually rapid.	Liable to spread rapidly and deeply; enclosing the great vessels, and pressing on the trachea, pharynx, &c.	No.	No; or only in small portions.	Known by their rapid diffusion and absence of distinct limitation, together with the usual symptoms of cancer; the cachexia often marked.
Enlargement of thyroid.	Often in females; originating about puberty. Growth generally slow and limited.	Lobulated swelling confined to the situation of the gland or one of its lobes; very seldom compressing the trachea, and hardly ever the great vessels.	Moves very freely with the action of deglutition.	Often contains large cysts.	Diagnosis generally quite easy. May pulsate, or be accompanied by protrusion of the eyeballs and heart-affection.
Induration of sterno-mastoid.	Usually congenital. Slow, or no increase.	Limited to the course of the fibres of the muscle.	Shares the movements of the muscle.	No.	

The Axilla.

There are a few particulars with reference to *abscess* in the axilla to which it may perhaps be worth while to give a little attention. Superficial abscesses, indeed, have no characters in this region to distinguish them from those of other parts of the body; but deep abscesses, i.e. those situated in the cavity of the axilla, internal to its walls, often constitute a grave malady. Cases are on record where such abscesses have burrowed beneath the muscular walls, into the neck, the back, and even the thoracic cavity. Their causes are various. Some depend on simple sprains or contusions, or occur without visible cause; others on lymphatic inflammation; others on caries of the bones of the thorax or of the shoulder; or even, it is said, on empyema or vomica.* The symptoms of the spontaneous abscess will usually be more acute than those of the symptomatic; but the only reliable diagnostic sign is a thorough examination by means of the probe, under chloroform if possible.

It is of great importance in acute abscess of the axilla to procure a ready and free escape for the pus; since if the opening is small, and the abscess is allowed to get into a chronic condition, it is very liable to fall into the condition of a sinus, which is then kept from healing by the action of the muscles. Therefore, if the abscess is seen before opening, a free and large incision should be made, care being taken to keep the edge of the knife towards the thorax, in order to avoid the large branches of the axillary vessels and nerves which lie towards the humerus. If the abscess be in a chronic condition, and no evidence of diseased bone be detected, the treatment is not easy. If the arm be kept at perfect rest, and the patient be well nourished and fattened, the abscess is most likely to fill up, but it will be at the risk of some loss of motion from cicatrisation and adhesion. This seems, on the whole, the best course; for laying open the whole cavity may do more harm than it is meant to obviate. Sinuses must be treated in the usual manner by stimulating injections, setons, or drainage-tubes, with rest. If adhesions or cicatrices have formed, their subcutaneous division will be indicated; and should much skin have perished, it may be thought right to free the cicatrix from the sound skin in its whole extent, and cover it with a transplanted flap.

Tumours occupying the axillary space, like those developed in other situations where large loose areolar intervals exist, are liable to grow to a very large size before they produce so much distress as to oblige the patient to request relief from a surgeon. In examining such a tumour two main questions present themselves: first, whether it is innocent or malignant; second, whether, if innocent, its relations are such as to permit of its removal. It is true that even in the case of a tumour judged to be malignant, if it could be very clearly separated from the periosteum of the humerus, it might be proposed to excise it; but in most cases of cancer, amputation would be the preferable course, if any operation were admissible. Nothing need be said here about the diagnosis of innocent from malignant disease, this being the same in the axilla as in other parts. We pass on to the question of the relations of the tumour. Superficial tumours are decidedly rare in this region. Notwithstanding the hairy condition of the integument, sebaceous tumours are hardly ever met with. I do not remember to have ever seen one removed from the axilla. The tumours which lie below or in the fascia are of course less movable than those in the subcutaneous areolar tissue. If the mobility be extremely limited, this may be due either to their attachment to the bone, or to their being connected with the sheath of the vessels; the former tumours will be almost immovable, and there will probably be no interference with the circulation; the latter will enjoy somewhat more movement, and the circulation will be more or less impeded. If the venous congestion and œdema be well marked, while the pulse is unaffected, there is direct evidence of pressure on the vein;

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* Nélaton, *Path. chir.* vol. v. p. 875.

while if the pulse be also weakened, the tumour probably envelopes and compresses both vessels. Its relations to the nerves will generally be determined by the occurrence of twitching, 'pins and needles,' or numbness. Tumours adherent, even over a great extent, to the sheath of the axillary vessels, may be removed with success by a daring operator, as Langenbeck's experience shows; and even if it were necessary to tie both of the vessels, it would be better to run that risk than to sacrifice the arm: but when the nerves are also involved, the case becomes almost desperate, especially as the most important of the nerves—the median—will be in all probability the most deeply implicated.

Exostoses and other tumours springing from the upper end of the humerus may project into the axilla, and may come into more or less close relation with the vessels and nerves. Thus in the case of a lad under my care at St. George's Hospital, a large exostosis, lapping round a great part of the humerus, raised up the artery for a considerable extent. But there is little risk of injury to the main vessels in operating on these cases, since the muscles which separate the bone from the artery can hardly have been atrophied, unless the tumour has attained most unusual proportions. The greater danger is to the circumflex or musculo-spiral nerve, as the case may be. In my case the tumour was so extensive as to trench closely on the position of both of them; but as there were no symptoms of pressure on either, I felt confident that it might be removed without injury; as turned out to be the case. Softer tumours implicating the periosteum of the humerus are always to be looked on with suspicion, since many of them are malignant. But if any doubt exists on this point, the minor operation of excision of the tumour and head of the bone should, no doubt, be resorted to. Sir W. Fergusson, in his recent lectures at the College of Surgeons, gave two cases in contrast with each other strikingly illustrative of the advantages of the course recommended.* In one, which was under Mr. Syme's care, that surgeon removed the head of the humerus with the tumour in 1860. A year afterwards, the disease recurred in the scapula; and in Nov. 1862 the scapula and a portion of the clavicle were removed with perfect success, leaving the patient with a useful arm.† In the other case, the arm had been amputated at the shoulder-joint before the patient came under Sir W. Fergusson's care, who was obliged, by the recurrence of the disease, to remove the scapula. A case under Mr. Hutchinson's care ‡ shows that, even in malignant tumour of the humerus, its removal by the operation of excision may be followed by the union of the wound, but does not give much encouragement for the practice, since the patient's life does not seem to have been prolonged by it. It is right, however, to add that the operation was performed by Mr. Hutchinson only after amputation had been refused by the patient.

The removal of *enlarged glands* from the axilla is generally a very simple matter when performed, as it usually is, as part of the operation for scirrhus of the breast; since the glands affected lie near the pectoral muscle, away from the large vessels. The extirpation of strumous glands is a measure of doubtful prudence; § and yet if there is no other indication of the strumous cachexia, and the tumour is productive of much inconvenience, such operations are sometimes undertaken. I once performed such an operation on a child, and ascertained that the patient remained in good health and free from any other manifestation of struma for at least a year, after which time I lost sight of her. An operation of a similar kind is reported in the *Lancet*, 1850, vol. ii. p. 22, as having been performed by Sir W. Lawrence. But if the surgeon determine on this proceeding, he must not deceive himself as to its probable difficulties and dangers. In loose cellular spaces, as the axilla and the neck, besides the glands which are perceptible before the operation, there are sure to be others more deeply situated which are only perceived after the removal of the first. This has been the case in all such operations as I have witnessed. It was so in the instance referred to under Sir W. Lawrence's care, as well as in my own case, and in two such operations which I have witnessed in the neck. In my case the axillary artery was wounded—I believe inevitably. In one of the cases in the neck to which I refer a considerable mass of disease was left behind. In Sir W. Lawrence's case the difficulties and embarrassments seem to have been great, and would have been very disagreeable anywhere except in hospital practice, where plentiful resources and assistants are always at hand. Again, in most of these cases (as in three of the above four) the glands have been found to be in a state of suppuration; and it must remain doubtful whether nature would not have accomplished the removal of the strumous tubercle in this way as completely as the surgeon. Therefore such measures should only be resorted to after the most mature consideration; and everything should be at hand which is necessary for a prolonged and difficult dissection among large vessels and nerves.

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* *Lectures on the Progress of Anatomy and Surgery*, pp. 46–49.

† Syme on Excision of the Scapula, 1864, p. 22.

‡ *Path. Soc. Trans.* vol. viii. p. 346.

§ See the essay on SCROFULA, vol. i. p. 370.

Langenbeck, in the paper above referred to (page 979), has dwelt upon the frequency with which the tumours, glandular and others, developed in the axilla are found attached to the sheath of the large vessels, and on the best means for extirpating them. That innocent tumours may be removed with success, whatever be their size and however extensive their connections, is proved by the case related by Langenbeck,* in which he removed a portion of the clavicle affected by a tumour dipping deeply in between the jugular and subclavian veins, and affecting the scalenus anticus muscle, which had to be divided.

Langenbeck recommends that the anterior surface of the tumour be freely exposed, the muscles being divided as far as may be necessary. In one of his successful cases, both pectoral muscles, the deltoid, and a portion of the coracobrachialis were divided. The tumour is then to be exposed by a free division of its capsule, and the vessels are to be sought for above, where they enter into the tumour. This course he prefers to the opposite plan of exposing the artery and vein at the lower part, for similar reasons as in the neck (see page 983). The sheath of the vessels, infiltrated by the disease, must be carefully divided and stripped from the vessels, which should only be tied in the last resort. If the great nerves be implicated in the tumour, so that they cannot be cleared away from it, amputation will become necessary. I recommend a very careful study of Langenbeck's cases to anyone who intends to perform one of these operations. A good idea of the probable relations of the tumour will be found by noticing the presence or absence of pricking sensations down the course of the nerves, or loss of their functions, of œdema and venous engorgement, and of alteration of the pulse. In cartilaginous or hard fibrous tumours, processes may project, deep in the axilla, among the vessels and nerves, or may run under the clavicle and approach the subclavian vessels and the pleura, and much add to the embarrassments and dangers of the proceeding. This is still more the case when the tumour originating in the neck has passed down into the axilla, as in Langenbeck's case, referred to above, in which the pleura seems to have been freely exposed, though not opened; and the patient afterwards died of pleurisy. However, in a case of a large fatty tumour of the root of the neck, which was under my care some years since, at the Hospital for Sick Children, and which sent a process down into the axilla, the removal was easily and safely effected from the main wound in the neck. A drainage tube was passed through the cavity in the axilla, and out below the edge of the pectoralis major. The child recovered without any deformity or bad symptom.†

In cases of tumours which implicate the axillary vessels, the vein is often the one which is most firmly attached to the tumour. This is a consequence partly of its position and partly of its being (like all veins) more readily affected by

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* I mean with success so far that no fatal injury was done to the parts. The patient died of the after consequences of the operation.

† *Surgical Treatment of Children's Diseases*, 2nd ed. p. 371.

TABLE OF THE CHIEF SURGICAL AFFECTIONS OF THE AXILLA.

	Origin and Progress	Fluctuation	Bruit	Pulsation	Accompanying Symptoms
Enlarged glands	In connection usually with disease of the parts from which the lymphatics come. Progress slow.	No.	No.	No.	When not associated with disease of the lymphatics, one of the usual constitutional affections will be present.
Abscess of glands	Origin as above. Progress rapid, and skin soon implicated.	Yes.	No.	No.	
Subpectoral abscess	Often from injury. Progress rapid.	Not always perceptible.	No.	No.	In cases of doubt an exploratory puncture clears up the diagnosis.
Cysts	Origin remote. Progress slow, or none.	Yes.	No; or only a 'thud.'	No; or only communicated from the artery.	
Aneurism	Originating often in accident. A defined tumour, growing more or less rapidly.	Variable.	Yes.	Yes.	The pulse in the affected and sound arm will probably differ.
Ruptured artery	Originating in accident. An ill-defined swelling; often hardly increasing at all.	Probably.	Yes.	Very probably not, or very obscure.	See the observations on p. 553 of vol. iii.
Innocent tumours	Origin remote. Progress slow.	No.	No.	No.	The various effects of pressure on the vessels or nerves may be present, and should be carefully noted before proceeding to remove the tumour.
Cancer	Origin less remote. Progress rapid.	No.	No.	No.	The vessels and nerves are far more likely to be surrounded by the tumour, or even infiltrated with cancer.

pressure. Consequently there is more risk of wounding the vein than the artery in such operations. In case of wound of the vein, the late Mr. Moore recommended that the artery should be secured as well as the wounded vein, and he used to refer to a case in which he had adopted this practice successfully. He believed, on the authority of this case, as well as of some of the others quoted above in which the main artery and vein have been tied in the removal of cervical and other tumours, that phebitis is less likely to follow, and that the risk of gangrene is not increased by the ligature of the artery. I may add, that when in such operations the brachial plexus is also injured, the limb should be removed at once. I had occasion some time since to regret not having followed this course. In an attempt to extirpate an extensive recurrent cancer from the axilla, I was obliged to secure both vessels. The parts were very much matted, thickened and difficult to distinguish. The patient died of gangrene, and on post-mortem examination a portion of the median nerve was found to have been embraced in one of the ligatures.

The Thorax.

The diseases of the thoracic viscera being the exclusive province of the physician, and their injuries having been treated of in our second volume together with the surgical operations practised upon the pleura, no observations on the regional surgery of the thorax are required here, except a few lines on the subject of abscesses in the thoracic parietes. Such abscesses may arise spontaneously as the result of acute or chronic inflammation, or may be symptomatic of disease of the bones. Diffuse inflammation is the most common cause of the first kind of abscess. It is a serious affection, being often productive of much distress by its local action, as well as testifying to the existence of a grave constitutional malady. Nélaton * speaks of a case in which the dyspnœa was so great as to lead to the erroneous diagnosis of visceral inflammation; an error the more likely to be committed since the inflamed condition of the integuments forbids physical examination. Besides, visceral inflammation may ensue : for the inflammation tends to spread inwards, and if unchecked leads to the formation of abscesses which may extend beyond the walls of the thorax, and make their way into its interior. Active treatment is therefore necessary. If the case is seen before abscess is formed, free incisions must be made, and the other means adopted which have been prescribed in the essay on Erysipelas for the treatment of diffuse cellular inflammation. If abscess have already formed, it must be opened without delay. The constitutional treatment must be guided by the general symptoms, and by the presence or absence of pleuritic complication—a fact which can only be inferred from the symptoms, if the condition of the parietes forbids direct examination.

Chronic abscess of the chest, unconnected with diseases of the bones, appears generally to take place in strumous subjects, and often in those who are suffering from or predisposed to phthisis. The treatment is the same as in other cases of strumous abscess. Many of those cases which are described in books as abscess pushing the pleura inwards, thickening it, and encroaching on the cavity of the chest, may very likely have been cases of limited empyema; at any rate they could hardly be distinguished from the latter except by the history, often an obscure guide in a chronic complaint. The treatment would consist in laying them open; and if this does not suffice, in providing a counter-opening, and keeping them empty by means of a drainage tube. In some cases of empyema much benefit has seemed to be derived from a counter-opening, and the injection of iodine; and the same benefit might be more confidently expected in chronic abscess not connected with the pleural cavity, without the dangers which must be allowed to accompany the iodine injection in empyema.† It is not, however, always easy to know whether a small opening may not exist into the pleura, or even the tissue of the lung. An open abscess, whose wall is in contact with the pleura, will follow its movements. Hence in inspiration its wall will be drawn inwards, and its cavity filled with air, which will be ejected in forced expiration.

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* *Path. chir.* vol. iii. p. 497.

† In one case at the Hospital for Sick Children, iodine injection had been used several times with benefit, when suddenly one day the child coughed up a quantity of

Most abscesses, however, in the walls of the thorax are symptomatic of disease of the ribs or sternum. The disease is generally caries, though necrosis is sometimes met with; and in some cases, at any rate, it is clearly traced to an injury—usually fracture of the sternum, or separation of its first joint. Thus Nélaton (loc. cit.) quotes from J. L. Petit and from Stalpart Van der Weil cases in which after gunshot contusion, and after a sword thrust, abscess formed on both surfaces (as it seems) of the sternum, and in which, after cutting down on the front of that bone, the surgeon perforated it with the trephine, and evacuated the matter from the anterior mediastinum. But what the indications for this proceeding were, the accounts appear too meagre to inform us. When, as is more usual, the abscess proceeds from caries of the rib, it appears better not to be too active. The partial resections of the ribs which are spoken of in foreign works on surgery, and which have been chiefly practised in Germany, do not seem very promising operations, while they are by no means free from difficulty and danger. The indications for attempting the removal of a portion of carious rib would be, if it were evidently setting up pleuritic irritation, or if it concealed and shielded a sequestrum on the inside of the bone, which could not otherwise be extracted. In accident, the indications for excision are, if the fractured portion conceals a wounded vessel or traumatic aneurism. If the whole depth of the bone be not diseased, the surgeon would of course desire to avoid wounding the intercostal artery, the bleeding from which is often troublesome. In such cases it would be sufficient to detach the muscles from the upper border of the bone, and carefully chisel away the diseased portion. But if the entire thickness of the bone is to be removed, a small incision must first be carefully made through the muscular parietes, and extended on the director as far as may be necessary to separate the muscles from both edges of the rib to the whole length which it is proposed to remove. Then the internal surface of the bone must be freed from the pleura with the handle of the knife, or some more appropriate flat smooth instrument, and the section made with a Hey's saw.*

Nélaton describes, after Boyer, an operation for the removal of diseased parts of the sternum, in order to evacuate matter confined in the mediastinum, and to remove the source of such suppuration. This has the distinction of being one of the most ancient surgical operations, and was performed by Galen. If a surgeon had made up his mind to make trial of the operation, he would need no very precise directions for its performance; as it consists merely in exposing very freely the surface of the bone, and applying the trephine on all the part which appears diseased; but it seems a doubtful and very hazardous measure, and could only be justified by the presence of severe dyspnœa, for which no cause, except the disease of the sternum, could be discovered. In Heyfelder's work (p. 308) will be found a notice of twelve cases in which this operation has been performed in modern times, and only one of which is said to have died from the operation. But real evidence of success seems wanting in the majority of these cases.

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the injection. This was followed by very severe bronchitis. The same accident happened to a child under my care at St. George's Hospital, but was not followed by any alarming symptoms.

* As to the statistics of this operation, Heyfelder says that out of thirty-seven cases of which he has accurate accounts, eight died; the rest recovered, and very speedily too. *Operationslehre und Statistik der Resectionen*, 1861, p. 303.

The Abdomen.

Very little of importance has been left for our consideration in this place as to the regional surgery of the abdomen, except abdominal tumours, since its injuries and the surgical diseases of all the viscera, digestive, urinary, and generative, have been described in separate essays. The first consideration in determining on the surgical treatment of a tumour of the abdomen, is whether it lies above or below the muscular expansion. It is possible that tumours may also form between the muscles, but the circumstance does not seem to have been put on record. Superficial tumours of the abdomen are usually fatty. Their superficial situation is recognised by the ease with which they move on the deeper parts, and by their being unaffected by the action of the muscles: the usual dimpling of the skin when pinched up over them, and their lobulated exterior, proves their fatty nature. The only caution which can be required in their removal is to remember that occasionally fatty tumours in the middle line of the abdomen have been found to perforate the abdominal parietes; and, although apparently superficial, to spring from a root in the subperitonæal fat. Such tumours are called by French writers 'hernies graisseuses.' * Their connection with the peritonæum varies in different cases. The greater part, and usually the whole, of the tumour is formed by the subperitonæal fat merely; but in some cases a small process of peritonæum has been found in the centre of the mass, having apparently been pulled down by the traction of the tumour. At other times cysts have been found in the fat, unconnected with the peritonæum. Usually these small tumours require no treatment; but several cases are recorded in which symptoms of colic or of peritonitis have existed, which have been thought to have depended on the traction of the tumour, and which at least have subsided on the removal of the latter. When such symptoms are present, there would often be a good deal of difficulty in distinguishing the case from one of strangulated hernia. In cases of doubt, it is justifiable to cut down and examine the swelling, taking care to unroll the mass of fat before cutting it away, for fear of wounding one of these peritonæal pouches; but M. Nélaton gives the caution not to be in too great a hurry to operate on these tumours; and this advice coincides with that given by Mr. Birkett, essay on HERNIA, vol. iv. p. 730, in all cases of umbilical hernia, where the symptoms do not very plainly indicate strangulation.

Other superficial tumours, whether innocent or malignant, differ in no respect in this region from their usual characters in other parts of the body. A word of caution may be given as to diagnosis. Most surgeons must have seen psoas abscesses mistaken for tumours of the abdomen—a mistake not very creditable to the care of the person who makes it, since it shows that he has neglected to enquire into the history and symptoms of the case; but easy enough to commit on a mere cursory inspection of the part.

The deep tumours of the abdomen, which lie beneath the muscles, are next to be distinguished into loose tumours, tumours of the bones, and tumours of the viscera or peritonæum. Of the loose tumours, some lie in the subperitonæal cellular tissue. Among these I would especially call attention to a tumour of the iliac fossa described by M. Nélaton,† and of which an instance occurred under my own care.‡ It is a firm rounded tumour lying in the venter of the ilium, moving with tolerable freedom under the muscular wall of the belly, and with a stalk which can be distinctly traced to the inner surface of the ilium, near the anterior superior spine. M. Nélaton has seen more than fifteen cases; and it is a singular circumstance that all his patients were women who had borne children. This was so in my case also. He had operated twice with success, although in one instance he had been unable to avoid opening the peritonæal cavity. The tumour is of the fibrous or fibroid variety, and certainly bears to the naked eye a strong resemblance to the recurrent fibroid; but it did not recur in either of M. Nélaton's cases, and in mine for more than a year, during which I saw the patient from time to time, there was no sign of renewed growth. In removing such tumours great care must be taken to avoid the peritonæum, if possible; and it is well to be contented with as small an incision as will suffice to expose the whole tumour; since ventral hernia will most likely ensue, and the patient's comfort demands that the hernia should be as small as possible.

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* Nélaton, *Path. Chir.* vol. iv. p. 394.

† *Gaz. des Hôp.* Feb. 18, 1862.

‡ *Path. Soc. Trans.* vol. xv. In the operation the peritonæum was not opened, and the patient recovered.

The singular peculiarities of this tumour in having always a pedicle from the crest of the ilium, and in occurring always in the same form, and always, as far as present experience goes, in women who have had children, appeared to deserve a special notice for it; but fibrous and other tumours may of course be found in other parts of the subperitonæal space. To all such tumours the same observation will apply, that the surgeon should wait awhile and be in no hurry to extirpate them, unless the fact of steady growth is well ascertained; and that in doing so he must take every precaution both to avoid danger from a wound of the peritonæum, if possible, and to guard himself from undeserved blame, should the tumour adhere so firmly to the membrane that its avoidance is impossible.

Malignant tumours, forming below the abdominal wall, will soon become fixed, from implication either of the viscera or the muscles; and thus the diagnosis will in all probability be correctly made during the interval of expectation above recommended in the treatment of deep-seated tumours which appear innocent.

Tumours which enjoy a wide range of motion are met with now and then in the abdomen, and are believed to be in many cases floating kidneys: but many of these tumours have had a range of motion far beyond what the kidney can possibly obtain.* In such a case as I once heard of from a friend, where a lump in the belly could be moved from a little below the liver in a curved direction down into the iliac fossa and thence over towards the middle line, always maintaining the same limits, the loose body must have been either a foreign substance in the intestines, which was unlikely in that case from the direction and range of its motion, or more probably one of those concretions in the peritoneal sac so well described by Dr. J. W. Ogle and others.† The limits to the range of motion of such a substance might easily have been fixed by accidental adhesions. The point is one of not much practical importance, since in hardly any circumstances would the idea of cutting down on such a substance be entertained; yet if it seemed to be setting up peritonæal irritation, such a proceeding might not be wholly unjustifiable.

The tumours of the bones are generally malignant, though enchondromatous and other innocent formations may occur. They are found in the iliac fossa, or in the pelvis, by examination from the rectum or vagina, or lying on the spinal column. They are recognised by their fixed condition, and the broad base which always connects them to the bone. They frequently compress, and often implicate, the great veins, giving rise to œdema and venous congestion in the parts below. Some of the more malignant of these tumours pulsate, and thus simulate aneurism. The diagnosis has been spoken of in the essay on **ANEURISM.**

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* Rokitansky says, 'The occasional movability of the kidney is owing to insufficient fixation by means of the adipose fascia, and apparently also to an elongation of the vessels: we sometimes find that the kidneys can be moved from one to two inches along the spinal column.' Path. Trans. vol. ii. p. 188, *Syd. Soc. Trans.*

† *Path. Soc. Trans.* vol. vi. pp. 204, 208. Vol. viii. p. 212: in this case the loose body was larger than a billiard-ball. Vol. xii. p. 89: here the loose body was felt in a hernial sac before operation. Other specimens will be found described in the same Transactions.

The tumours which affect the spine, if they are large enough to be perceptible externally and to give rise to symptoms, are almost always malignant, and may sometimes be distinguished also by examination from the loins. The small exostoses, so common in old age on the front of the column, do not usually give rise to symptoms, and could hardly be felt from the outside of the body. None of this class of tumours is susceptible of treatment.

Tumours of the viscera of the abdomen constitute such a very large class, and are so very complicated in their diagnostic signs, that no sufficient exposition of the subject can be attempted here. They affect the liver, the omentum, the spleen, kidney or intestine, the general surface of the peritonæum, the bladder, and in the female the uterus, ovary, or broad ligament. Nothing need be said here about the tumours of the intestines, or of the female generative organs, or of the urinary organs, since these have been treated of in the essays on those subjects.

Tumours of the liver are recognised by their position, by their comparative immobility, and by their being situated in an area beyond which the liver can be recognised as extending (either by touch or percussion), or at least by the liver's dullness extending quite up to them; and when situated on the edge of the organ by their raising the false ribs. Such tumours as are merely attached to the liver * will be more movable; but it would be difficult during life to recognise these as hepatic.

The tumours of the liver met with in surgical practice are either cystic or malignant. Sir B. Brodie has described, in his Lectures on Pathology and Surgery, some cases of watery cyst of the liver, in which no proof was given of the presence of hydatid animalcules, and in which a cure was effected by simple puncture with a trocar; in two cases without any symptoms, in another after severe inflammation, and the bursting of an abscess into the intestine, followed by the discharge of a membranous bag, which, however, Sir B. Brodie did not regard as a hydatid.†

Large hydatid cysts are accompanied by considerable enlargement, the tumour being rounded and smooth, fluctuating, but less distinctly than the watery cyst, and with a peculiar vibration, due to the presence of the semisolid bags in the fluid.‡ The smaller hydatid tumours, which are not perceptible externally, will not give rise to any symptoms. After some time ulceration may be expected to take place, by which the hydatids are transferred to some of the neighbouring viscera, or the sac suppurates and an abscess forms, which may burst internally or externally. In the latter event, the patient may survive; the others are almost inevitably fatal. Space would fail us to pursue the history of the disease if left to itself; our only object here is with its diagnosis and surgical treatment. The diagnosis of hydatid cysts is to be made from (1) an enlarged gall-bladder, (2) abscess, and (3) cancer. Other ambiguities may occur; e.g. when the cyst rises into the thorax it may be confounded with pleuritic effusion; when it lies in the central part of the abdomen, with aortic aneurism, and other similar difficulties may be met with, but these are rare. It will suffice here to point out the ordinary diagnostic signs. In the first place, then, hydatids grow without any feverish or hepatic symptoms, which is a strong point in their diagnosis from abscess of the liver, and from enlarged gall-bladder. Otherwise the resemblance of some hydatid cysts to an enlarged gall-bladder is very striking; and it would be almost impossible to tell the difference by manual examination merely, as

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* As the hydatid tumour figured in Frerichs on 'Diseases of the Liver,' vol. ii. p. 242, *New Sydenham Society's Trans.*

† The occurrence of simple cysts in the liver, and the frequent coexistence of that condition with cystic degeneration of the kidneys, is illustrated in papers by Dr. Bristowe and Dr. Wilks, in *Path. Soc. Trans.* vol. vii. and x.

‡ This sensation is not always perceptible. Davaine recommends that in order to feel it, three extended fingers be applied to the most prominent part of the tumour, and that percussion be made with the middle one. Frerichs, op. cit. p. 242.

a reference to Frerich's plate, mentioned in the note, will show. Next, the smooth round surface of the hydatid swelling usually distinguishes it from the more lobulated mass formed by a large cancer of the liver; and, lastly, the fluctuation and vibration of a hydatid tumour are in some cases to be clearly and easily distinguished from the semi-solid feeling of cancer. But it must be allowed that, in very soft cancers with smooth surface, if constitutional symptoms be absent, as they often are in rapidly-growing medullary cancers, the diagnosis can hardly be made without an exploratory puncture, which should in such a case always be employed.* I have seen cases in which the disease could not possibly be diagnosed without it.

When by puncture fluid (whether purulent or limpid) is discovered superficially situated in the liver, the question occurs whether it is right to open the collection, and if so, how? In case of abscess it would be advisable to open the collection as soon as practicable; and the safest way is by means of caustic (see vol. i. p. 139). In the case of a hydatid tumour, it seems better to wait until the fact of growth is decidedly established; since such tumours sometimes remain long stationary, and the operation is a dangerous one. But if the cyst be increasing in size, and if it be superficial, the risk of leaving it alone becomes probably greater than that of operating. Several plans are in use. The one which was till lately, I think, the most common in English practice, is to make an opening into the sac with potassa fusa; other plans are to cut down on to the peritonæum, have the wound stuffed with charpie in order to excite adhesions, and then, after a few days, prolong the incision into the cyst; or simply to puncture and evacuate the tumour, as was done by Sir B. Brodie; or to keep the puncture open, and establish a sinus, through which the sac is washed out with warm water, diluted alcohol, solution of iodine, or even bile. Iodine is the fluid which has been generally used; but Frerichs seems to speak favourably of the use of bile as causing less pain, and correcting the putridity of the contents of the sac.

In a very interesting paper published in the *Med.-Chir. Trans.* vol. xlix., Dr. John Harley has related a case in which he effected the cure of a large hydatid tumour of the liver (the largest on record in which operation has been practised) by puncturing the sac above the umbilicus with a large trocar and canula, tying in the latter till it lay loose in the wound it had caused; the canula being kept free from obstruction by a catheter passed through it from time to time, and then supplying its place by two or three elastic catheters, the size of which was gradually increased until three or more of the size of No. 12 could be readily introduced. Iodine was freely injected through these catheters from time to time, and to prevent decomposition the sac was freely washed out with creasote water, of which, on one occasion, more than a gallon was passed through the sac, being injected through one of the catheters and running out by the others. Severe symptoms occurred during the treatment from hæmorrhage and discharge of bile into the sac. These were combated by strict attention to bandaging, and by the use of injections of sulphate of zinc and nitrate of silver. Dr. Harley appends to his paper a synoptical table of the published cases in which operative measures have been employed, to show the superiority of a free puncture of the sac, and its careful evacuation, over those plans of treatment in which the latter point is not secured. He rejects the method of opening the sac by means of caustic potash, as being much more painful and tedious than that by the large trocar, while it is not in his opinion at all safer. The point on which he lays especial stress is the necessity of providing free exit for the cyst-membranes, and a constant discharge for the fluid, which if retained will putrefy and poison the blood.

If there be much redness, and the fluid seem very near the surface, it may be thought justifiable to open the tumour by a simple incision; but it is dangerous, as the least escape of cyst-fluid into the peritonæum may set up fatal inflammation. If by palpation or on puncture the cyst is found to have undergone calcareous degeneration, as is not uncommon, no operative interference is justifiable.

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* It is a measure, however, not absolutely devoid of danger. Frerichs (op. cit. p. 251) gives a case where death was caused by tapping a hydatid cyst and drawing off some of its contents with an exploring trocar.

Tumours connected with the spleen and the omentum less frequently come under the surgeon's notice, since they are not the subjects of surgical treatment. The former are chiefly known by their situation, and by their raising the false ribs on the left side, as hepatic tumours often do on the right. Cystic or other tumours in the omentum appear more pedunculated than visceral tumours, and give rise to few symptoms when solitary; but the colloid and other soft formations usual in this part, are often merely part of a general affection of the whole peritonæal surface, leading rapidly to death.

It is certainly theoretically possible that some of these looser tumours within the abdomen should be made amenable to surgical operations analogous to those on ovarian cysts; but practically it will be very difficult to find a case in which there shall be at the same time sufficiently urgent symptoms, and yet sufficient evidence of constitutional immunity, to justify a surgeon in exposing his patient to the incalculable risks of such an operation.*

The Groin.

The fold of the groin is one of the most fertile regions for the materials of surgical diagnosis; but most of these materials have been already treated of. Thus, in the essays on HERNIA and on the DISEASES OF THE MALE ORGANS, all the difficult and complicated questions of diagnosis connected with hernia, retained testicle, cysts of the spermatic cord, and all the varieties of hydrocele, have been studied, and the diagnosis of psoas abscess has been laid down in that on DISEASE OF THE SPINE. Artificial anus, again, as well as iliac abscess, and the abscesses forming round the caput cæci, have been spoken of in the essay on DISEASES OF THE INTESTINES. The affections of the skin of the groin, among which intertrigo is very common, will be found described in DISEASES OF THE SKIN and ERYSIPELAS. The chief points which remain for notice are the affections of the lymphatic glands, and the rare instances of bursal tumours and cysts unconnected with the testis or cord. The tumour formed by an enlarged gland may often be confounded with a hernia; but on this point it is only necessary to refer to vol. iv. p. 771. The mobility of the glands distinguishes all except that which lies in the femoral canal. In such cases the regions from which the inguinal glands derive their absorbents, viz. the lower limb (especially the toes), the wall of the abdomen, the nates, anus, and genitals, must be carefully examined, for the disease in the groin is but a symptom. The after consequences of abscesses forming in these glands are often formidable, since they lead to ulcers with callous edges, in which often the enlarged and diseased gland is to be seen, or to sinuses which are often very intractable. In the first place, the remains of the gland should be extirpated with the knife, or destroyed by some caustic; the latter being perhaps the best plan, as these glands have little sensibility. If this does not suffice, the hard edges are to be destroyed with potassa fusa; or, as a last resort, chloroform is to be administered, and all the sinuses laid open to their very bottom by free and extensive incisions, the hardened edges being at the same time pared away. The wound must then be dressed from the bottom, the patient kept at rest, and liberal diet given, if the stomach will bear it.

Cysts are sometimes found in the fold of the groin, which are formed in the bursa lying near the hip joint, under the tendon of the psoas muscle. If this bursa communicates, as it often does, with the hip joint, the fluid will pass into the synovial cavity on pressure, and the tumour disappear on the limb being relaxed. If the bursa is separate, the rounded tumour will be irreducible. The diagnosis will be made from a consideration of these circumstances, and from the position of the small rounded tumour. The treatment will be that laid down in the essay on DISEASES OF THE MUSCULAR SYSTEM, vol. iii. p. 651 et sqq. More liable to lead to error are those cysts and those abscesses which lie in close proximity to the femoral artery and receive pulsation from it. It is, however, sufficient to be aware of the occurrence (however rarely) of such diseases, and of the general rules for the diagnosis of aneurism (as laid down in the essay on that subject, vol. iii. p. 452), to avoid such a catastrophe as to mistake an aneurism for a cyst or abscess. But much caution ought to be used, remembering that sad mistakes have been committed on the subject.

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* The cases which have occurred since the statement in the text was written of removal of the spleen by Mr. Bryant, M. Kœberle, and others, appear to me amply to justify it (see the *Biennial Retrospect of the New Syd. Soc.* for 1867–8, p. 220), although it is true that the spleen has been successfully removed in the human subject by M. Péan, and perhaps by other operators, as a reference to the same publication will show.

Cysts of many other kinds may form in the groin—sebaceous, serous, sanguineous. Of these the sebaceous would differ in no respect from the ordinary disease as it takes place in other parts. The serous and other cysts are difficult of exact diagnosis without an operation; which should, however, be omitted until symptoms call for it. I have seen a blood-cyst dissected away from the sheath of the vessels in this part with good results. The patient was a young woman under Mr. Hewett's care.*

Connected with the surgery of the groin a curious and rare affection ought to be noticed, which is denominated by the German surgeons the 'rider's-bone,' and is attributed to ossification of the tendon of the adductor longus or magnus muscle as a consequence of injury; such as is not uncommon in riding, while endeavouring to maintain the grip of the saddle. The following case, which I quote by Mr. Birkett's permission from a paper written by him,† will best illustrate the subject:

'A gentleman, fifty-six years of age, was, in early manhood, much used to riding on horseback, and regularly hunted three days a week at the least, being always well up to the hounds. He has always enjoyed robust health, and is very muscular. Twenty-five years since, when riding in a steeple-chase, at about the age of thirty, in the act of charging a fence his horse, refusing the leap, swerved, and he felt something give way "snap" in the upper and inner region of the right thigh. Immediately after he felt he had not his accustomed powerful "grip" of the saddle. In the evening, even so soon after the accident, the thigh was swollen and bruised. It should be stated that he was neither thrown from his horse nor displaced in the saddle. The muscles of the right thigh were very weak for some months afterwards; indeed, the adductors have never regained their wonted power. Both Aston Key and Liston were consulted, and stated that they had never met with a like case. For at that time there existed a bony hardness in the course of the tendon of the adductor longus.

'At this time there is a large exostosis in the region of the right spine of the pubes, which extends along its horizontal ramus, and seems to envelope the pubic attachment of the adductor longus muscle. The tendon of this muscle is converted into bone at its root, and extending for three inches downwards in its substance a conical piece of bone is clearly perceptible. The apex of this is pointed, and rounded off at its tip, as if cartilaginous. In the tendon of the left adductor longus there exists a similar bony deposit about two inches long, but no exostosis on the pubes. The other adductors are unaffected on both sides.'

Dr. Billroth has described an ossification in the tendon of the adductor magnus, which he found in an after-death examination of an old cavalry man.

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* *Path. Soc. Trans.* vol. ix. p. 383.

† *Guy's Hospital Reports*, 1868. If I am not mistaken Mr. Hancock also drew attention to this affection in his Lectures on Anatomy and Surgery as Professor at the Royal College of Surgeons.

TABLE OF THE CHIEF SURGICAL AFFECTIONS OF THE GROIN.

	Reducible	Fluctuation	External inflammation	Impulse on coughing	Resonance on percussion	Other chief symptoms
Abscess, psoas	Partly.	Yes.	No.	Frequently.	None.	Evidence of diseased spine. Swelling in iliac fossa.
glandular	No.	Yes.	Yes.	No.	No.	Probably other inflamed glands, and some disease in the parts from which the absorbents come.
from diseased hip	No.	Yes.	Varies.	No.	No.	Pain, involuntary resistance, or grating on passive motion of joint.
simple	No.	Yes.	Yes.	No.	No.	Resilience of fluid in a limited cavity. Inflammation of neighbouring skin.
Enlarged glands	No.	No.	Varies.	No.	No.	Wound or other cause of irritation in parts from which the lymphatics come.
Cysts	No.	Yes.	No.	Very seldom	No.	Resilience of fluid in limited cavity. No surrounding inflammation.
Encysted hydrocele	Partly, sometimes.	Hardly perceptible.	No.	No.	No.	Resilience and absence of inflammation as above, with transparency. The cord running into the tumour.
Hernia, common	Yes.	No.	No.	Yes.	If large.	Disappears occasionally, spontaneously, or on taxis.
incarcerated	No.	No.	No.	Yes.	If large.	Similar history at one time. Has since become irreducible.
strangulated	No.	No.	No.	Not usually.	Occasionally.	The sickness, constipation, umbilical pain, and other severe symptoms attendant on strangulation.
Retained testis	Partly.	No.	No.	Sometimes, but obscure.	No.	Absence of testis from that side of the scrotum.
Varix of saphena vein	Yes.	Yes.	No.	No.	No.	Increased by pressure above; emptied when the circulation is stopped in the vein below.
Aneurism	No.	Variable.	Seldom.	No.	No.	Pulsation and bruit in most cases; affection of the pulse in the trunk below.
Malignant disease	No.	No.	No.	No.	No.	Infiltration of parts around with cancer; perhaps enlarged glands and cachexia.
Other tumours	No.	No.	No.	Seldom.	No.	Gradual increase of the swelling, with absence of all the above and all other special symptoms.

It extended in that muscle for half an inch below its attachment to the pelvic bones.*

Prof. Longmore, of Netley, informs me that he has seen the 'rider's-bone,' 'but extremely rarely.'

A similar local ossification of the soft parts, due to pressure and irritation, is stated to occur in the left arm of the Prussian soldiers, and is termed 'exercise bone.' †

Finally, it may be advisable to call attention to the occasional occurrence of disastrous or even fatal hæmorrhage from the spread of phagedænic, strumous, or cancerous ulcers in the groin. The diagnosis of these forms of ulcer presents no difficulty in the groin beyond what it does in other parts; but this peculiarity in the relations of the femoral artery should make us more than ordinarily anxious to stop the spread of specific ulceration in the groin. Powerful caustics, such as potassa fusa or nitric acid, are the only local measures which can be trusted to arrest such of these ulcers as allow of treatment. The more active forms of cancerous ulceration are, of course, hopeless.

The Popliteal Space.

The popliteal space is to be regarded, from a surgical point of view, as a large loose areolar interval in which the great vessels and nerves pass behind the knee joint, and whose size and the laxity of its tissues allow them to move freely out of the way of the ends of the bones in forced flexion and extension.

The glands which lie in this areolar tissue, the tendons and the bursæ in relation with them, must engage the attention of the surgical anatomist as well as the vessels and nerves. It is unnecessary for us here to go over the familiar points, which may be found in any treatise on descriptive anatomy; but it may perhaps serve a useful purpose to give an account of the usual arrangement of the bursal sacs which are in connection with the tendons.

In the *Archives générales de Médecine*, 1856, sér. v. tom. viii. pp. 313, 425, M. Foucher has written an elaborate memoir on the tumours produced by enlarged bursæ in the ham, which will well repay perusal. M. Foucher there gives a description of the usual arrangement of the bursæ, which my dissections (though less numerous than M. Foucher's) enable me to confirm. There are found, according to this author, on the inner side of the ham, two bursæ—one between the inner head of the gastrocnemius and the femur, which sends a prolongation also between the gastrocnemius and the semi-membranosus, and is in close contact with the ligament of Winslow. This bursa very often communicates with the joint,‡ especially if it is enlarged. The second bursa, at the inner side of the space, lies between the tendon of the semi-membranosus and its insertion into the head of the tibia. It is of smaller size than the preceding, with which it is in contact above, and sometimes in communication. In such a case this bursa may communicate with the joint, but not otherwise. Besides these, I have found, but only once out of nine dissections, a small bursa between the tendons of the semi-membranosus and semi-tendinosus, which is probably an accidental formation. On the outer side of the space a separate bursa is sometimes found under the outer head of the gastrocnemius, but more frequently merely a prolongation of the synovial membrane. There is also usually a pouch of the synovial membrane of the joint, between the front surface of the tendon of the popliteus muscle and the posterior ligament. This pouch may be replaced by a separate bursa. On the opposite (back) surface of the tendon, between it and the external lateral ligament, lying close to the peroneal nerve, there is usually a separate bursa.

Besides these regular and natural structures, which can always be recognised by dissection, there are also found other closed sacs, which appear to be diseased products. Thus M. Foucher notices that, in dissecting the popliteal space, he has occasionally met with cysts having no communication with the joint, and not situated in the position of the tendinous bursæ. These cysts he believes to be in most cases dilated synovial follicles;* although he admits the possibility that some of them may be formed by a hernial protrusion of the synovial membrane through an opening in the ligamentous capsule, which afterwards becomes obliterated.† Other cysts are found, though rarely, in the cellular interspaces, which appear to be simply accumulations of fluid in the meshes of the areolar tissue, which have become enclosed in a capsule. If we follow this division, we shall have four classes of cysts in the popliteal space:

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* *Deutsche Klinik*, 1855, No. 27.

† Virchow, R., *Die krankhaften Geschwülste*, vol. ii. p. 72.

‡ M. Foucher says, almost always in adults and old persons; a point which I regard as very doubtful.

1. Bursal cysts, or dilatations of the above-mentioned bursæ of the tendons.
2. Follicular cysts, or dilatations of the synoviparous follicles.
3. Synovial cysts, or cysts formed by hernial protrusions of the synovial membrane.
4. Free serous cysts, or accidental cysts.

It must, however, I think, be allowed that the second and third classes have not yet been proved to be anatomically distinct from each other.

The first question which occurs in examining a rounded tumour in the popliteal space is, whether it is an aneurism, an abscess, an enlarged gland, a solid tumour, or a cyst. There is usually very little difficulty in establishing the diagnosis of the latter form of disease—in fact, when the cyst projects from the outer or inner aspect of the limb, there can be hardly any ambiguity in the matter. This is the case in the great majority of instances; those cysts being, as far as I have seen, the most common which are formed by the expansion of the bursa lying between the femur and the inner head of the gastrocnemius with the semi-membranosus muscle. But when the cyst presents, as it occasionally does, in the centre of the space close upon the popliteal artery, it may very closely simulate an aneurism at first sight. The diagnosis depends upon these particulars: 1. The cyst, though it contains thin fluid, is not altered in size by compression applied while the circulation in the artery is arrested; the aneurismal tumour is emptied partly or entirely under similar treatment, while it contains fluid. 2. The sound communicated to the ear applied over the tumour is never of the same prolonged blowing character with that usually heard in aneurism. 3. The pulsation communicated to these cysts is never of the expanding character of the pulsation observed in an aneurism with fluid contents. 4. Most of these cysts can, in some position or other of the limb, be dragged away from the artery, and the pulsation in the tumour then ceases entirely, though that in the artery continues unaffected, which is never the case in aneurism. 5. To these diagnostic marks Mr. Hart, in reporting a case mistaken for aneurism,* has added, that in rigid extension of the limb the pulsation of the cyst almost disappeared. Finally, if, after a very attentive examination, the surgeon cannot yet make up his mind, it will be justifiable to clear up the doubt by inserting a grooved needle; but this measure will be hardly ever resorted to after a sufficient examination in any case which afterwards proves to be an aneurism.

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* On the nature of these synovial follicles, see Gosselin in *Mém. de l'Acad. imp. de Méd.* vol. xvi. He there establishes the following propositions:

I. The articular synovial membranes in general, and that of the wrist in particular, are provided with prolongations, or culs-de-sac, which he calls 'crypts,' or 'synoviparous follicles.'

II. The obliteration of the orifices of these crypts, and the accumulation of synovia in their interior, is the origin of the cysts in question (i.e. the ordinary ganglions).

These two propositions are applicable to the knee joint, though the occurrence is less common than in the wrist.

† In dissecting the popliteal space on either side in the body of a woman, æt. 38, I found on each side a large accumulation of fluid in the bursa beneath the inner head of the gastrocnemius. On one side there was no communication with the joint, which was perfectly natural, and contained no fluid. On the other side the enlarged bursa communicated with the synovial cavity, which also contained a considerable quantity of the same thick yellow fluid as the bursa. But, besides, there was on this side, adherent to the posterior surface of the ligament of Winslow, in its centre, a very small closed sac, containing similar fluid. The sac and the adjoining portion of the ligament, with its synovial lining, were removed from the body and carefully examined. No communication whatever existed, but there was a distinct pin-hole depression on the synovial face of the ligament, corresponding to the part where the cyst adhered. There were, therefore, strong grounds for regarding the latter as formed by a protrusion of the synovial membrane, or of one of the above-mentioned follicles, through the ligament.

It is impossible sometimes to diagnose the nature and connections of blood-cysts before dissection. Of this the following interesting case is an example: A woman was under the care of Mr. Moore, at the Middlesex Hospital, for a smooth swelling in the popliteal space, supposed to be a bursa. In a few months after she was first seen, the tumour appeared solid, deep-seated, and was thought to be a cluster of glands. Again, ten months later, it nearly doubled the size of the knee, projecting backwards in lobes between the hamstrings and gastrocnemius. It was doubtful whether it was solid or fluid, its feeling varying at different examinations. The chief symptom was acute pain darting along the nerves to the foot. Sometimes she could not bear a touch. On puncture with a grooved needle, slightly reddened serum escaped, which, as it flowed, became more and more red, till at last it became pure blood. Whilst the needle was held steady in the tumour, she suddenly cried out from excessive pain shooting to the foot. For three or four minutes after the needle was withdrawn, the tumour remained soft; but then acquired the same tension as before. A tourniquet was applied, and the tumour cut into. The sensation to the finger was exactly that presented by the right ventricle of the heart. Nothing but blood and a few fibrinous coagula escaped: the venous bleeding was very free. The limb was amputated, and the disease then proved to be a cyst, communicating with some deep vein, and developed like a neuroma in the substance of the posterior tibial nerve, the fibrils of which were expanded in all directions over it.†

Treatment of popliteal cysts.—The treatment of these cysts is usually successful. It may be conducted on the same principles as those already laid down in the essay on DISEASES OF THE MUSCLES as applicable to enlarged bursæ of tendons. But the frequency with which a communication exists between the enlarged bursæ of the hamstring tendons and the joint, and the probability that the cyst, if seated in the centre of the ham, may be a protrusion from the synovial membrane, should make the surgeon very cautious in treating these cysts by any of the severer methods, such as injections and setons. It is quite true that such methods have been used, and successfully, when the cyst has been known to communicate with the knee joint;‡ but they must always be held to be dangerous, and should not be resorted to unless after a patient trial of other methods (such as puncture, followed by blistering) which are free from any risk. These mild measures will often succeed, when combined with rest. Nor should it be forgotten that the communication with the joint is not always obvious even in cases where it exists. The opening may be but small, and pressure on the cyst may cause no appreciable quantity of fluid to flow into the joint, unless applied for a considerable time; or the opening being of the nature of a slit,§ may be closed in the extended position of the joint, though open when the knee is flexed. In any case, if injection be the method employed, the knee should be kept firmly extended. Iodine seems the best material for injection, though alcohol and ether have been successfully employed. The injection-treatment seems to have been so successful that the difficult and dangerous method of excision ought not to be resorted to in any case; and when the cyst communicates with the joint it is wholly out of the question. Setons should be reserved for use on the failure of injection.

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* *Med. Times and Gaz.* 1862, vol. i. p. 377.

† *Med.-Chir. Trans.* vol. xlix. p. 29.

‡ Foucher, op. cit. obs. i. p. 321.

§ See a case dissected by Foucher, op. cit. p. 320.

The diagnosis between an *abscess* in the ham and any of the affections with which it may be confounded is usually very easy. The inflammatory appearance of the integuments would suffice to distinguish it from a cyst, as well as from a solid tumour.* The chief ambiguity would be between an abscess and an aneurism in which suppuration of the sac has taken place; or between an abscess following injury and an effusion of fluid from rupture of the main vessels. On both these heads the investigation of the pulse in the artery below will give important and often decisive information. As to suppurating aneurism, the history and symptoms of aneurism will have existed, and, if the patient is a person of any intelligence, will not fail to guide the surgeon to a right conclusion. In such cases the aneurismal bruit and pulsation have generally been obliterated by the inflammation. It is true that an incision will be required, both in the abscess and in the suppurating aneurismal sac; but it is most important not to open a suppurating aneurism, believing it to be a simple abscess, since amputation may become immediately necessary; a contingency for which the surgeon should assuredly have prepared both himself and his patient.†

Rupture of the great vessels in the ham always, as far as recorded cases show, implicates the artery. The vein also may be torn in cases of ruptured artery; but I am unable to refer to a case where it has been the only vessel injured. The accident would be diagnosed from abscess by the suddenness of the occurrence of swelling, which comes on instantaneously at the time of the accident: the absence of inflammatory œdema or increase of temperature in the superficial parts of the ham, the loss of temperature in the foot, the failure of circulation in the lower arteries, and the tendency to gangrene.‡

The treatment of ruptured artery has been spoken of in the essay in ANEURISM, vol. iii. p. 523.

The regional surgery of the popliteal space would be very incomplete without the mention of that which is perhaps the most common cause of embarrassment in operations conducted in this region—viz. the frequent formation of a *sequestrum* in the part of the femur directly adjoining the popliteal artery. This sequestrum is seldom separated from the vessels by an invaginating sheath, as is usually the case in other parts of the body. No satisfactory cause for the commonness of the disease, or for the frequent absence of the periosteal sheath, seems to have been given. Numerous accidents in the removal of these sequestra have happened; the artery has been opened by the knife or the trephine, or lacerated by the sharp edge of the sequestrum; and cases in which the loose bone has been driven into the artery in the ordinary movements of the limb are on record, and have been referred to at vol. iii. p. 766. Hence much caution is neccessary in extracting such sequestra. A free incision at one side (the outer is best) should be made, and the dissection carried along the face of the bone until the dead bone is reached. If it be not thoroughly loose, the operation had better be deferred till it shall become so. If it be found loose, it should be gently raised from its bed with an elevator, and drawn outwards with flat forceps. If the extent of the dead bone be too great to allow of its ready extraction, it is better to cut it across with the bone-scissors than to use any force. If, notwithstanding all his

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* It should be remembered that cysts may suppurate as well as enlarged glands, and that abscess may occur in or near a solid tumour; but then such cases become abscesses, and must be so treated.

† Most readers will recollect the case, so well described by Roux (*Quarante Années*, &c. vol. ii. p. 48), in which Cullerier opened a suppurating aneurism in the groin.

‡ Compare Poland on Rupture of the Popliteal Artery, in *Guy's Hospital Reports*, ser. iii. vol. vi. 1860.

TABLE OF THE CHIEF SURGICAL AFFECTIONS OF THE POPLITEAL SPACE.

	Fluctuation	Pulsation	Bruit	External inflammation	Variation in size with the pulse	Remarks
Abscess (simple or glandular)	Yes.	Seldom, and never expanding.	No; or very rarely a simple 'thud.'	Yes.	No.	When dependent on lymphatic inflammation, there will be disease in the parts from which those vessels are derived.
Abscess from diseased bone	Yes.	No.	No.	Usually a sinus.	No.	Thickening around the bone, which can probably be struck with the probe.
,, ,, joint	Yes.	No.	No.	Usually.	No.	Crepitus of the joint surfaces will, in all probability, be detected under chloroform.
Bursal tumour, or cyst . .	Yes.	Seldom, and never expanding.	No; or merely a simple 'thud.'	No.	No.	The bursal cysts can frequently be emptied into the joint when the leg is bent; if they pulsate, this can generally be made to cease by drawing them away from the artery.
Aneurism	Variable.	Yes, almost always.	Usually.	No.	Yes.	
,, suppurating . .	Yes.	Usually not.	Usually.	Yes.	Probably.	The pulse below is probably affected.
Rupture of artery . . .	Yes.	Not usually.	Variable.	No.	Cannot often be made out.	The history is generally decisive; the swelling and colour of the limb, the loss of temperature and the impending gangrene, are also generally unmistakable symptoms.
Glandular tumour . . .	No.	Seldom, and never expanding.	No; or merely a simple 'thud.'	Usually not.	No.	The same remarks apply, as to glandular abscess.
Other innocent tumour . .	As above.	As above.	As above.	No.	No.	This and the preceding tumour can usually be drawn away from the course of the vessels, like the bursal cysts.
Cancer	Variable and varying in different parts of the tumour.	No.	As above.	No.	No.	The rapid increase in the tumour and the large veins over it are frequent symptoms.
,, pulsatile	Sometimes.	Yes.	Not usually.	Seldom.	Yes.	As above; it is only in rare cases that the bruit simulates that of aneurism. The bone is commonly enlarged for some distance.

care, the surgeon is so unfortunate as to wound the popliteal or any large artery, he must have the circulation commanded by pressure on the femoral, while he rapidly enlarges the wound and ties both ends. Failing this, amputation has been found necessary, and even death by hæmorrhage has occurred.

The Limbs.

In the continuity of the limbs, the chief questions connected with regional surgery which occur in practice are those which relate to the relative positions of arteries and nerves to tumours or diseased portions of bone. Interesting points of surgical anatomy are frequently raised by these operations, but they are too numerous and too miscellaneous for discussion here. An intimate and ready knowledge of anatomy is the chief requisite for safely conducting such operations; but the surgeon must not forget that tumours and abscesses often displace the structures. An instance of this has been given at p. 957, in the displacement which the femoral artery suffers in chronic abscess of the thigh; and similar displacements are of course still more common when tumours grow among the main vessels and nerves of a limb. For this reason, in the removal of such tumours, it is very desirable to commence the dissection from above, where the structures have their natural position, and thence trace them downwards. But the affections of the limbs have been so extensively described in the essays on the DISEASES OF THE MUSCULAR SYSTEM, BONES, JOINTS, and SKIN, that I must refer the reader to those essays for all that is necessary on their diagnosis and treatment.

T. HOLMES.

ON HOSPITALS.

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IF there be any merit in the following attempt, it consists in having brought together the scattered elements of a subject not as yet generally understood as a whole. The endeavour may be well capable of improvement, as well as of extension; and I shall esteem myself fortunate if I may at some future time enjoy the privilege of contributing both to the improvement and the extension of so beneficent a subject.

To pretend to originality in such an undertaking would be about as just and true as to pretend to write the original statistics of an empire, or to write a cyclopædia.

In considering the objects and uses of hospitals we must always hold in recollection that, however excellent and necessary in themselves, they have but a subordinate station in the great body politic of medicine, comparatively. They relate only to the cure of disease; and thus minister, according to Bacon, but to the 'necessities of mankind;' while the nobler division of the science of medicine aims at the promotion of the general welfare, by ministering 'to the Divine power and goodness both in prolonging and restoring the life of man.' Dr. William Farr, quoting the same great authority, says:— 'If physicians' (and we may add governments) 'will learn and use the true approaches and avenues of nature, they may assume as much as the poet saith:

> "Et quoniam variant morbi, variabimus artes;
> Mille mali species, mille salutis erunt."'

The objects and uses of hospitals are: the recovery of health; recovery from sickness in the shortest time, with the smallest mortality, and at the lowest cost consistent with efficiency.

But an army in hospital—as at Walcheren, at Rangoon, and in the Crimea—what availeth it to the statesman or the commander? It is an encumbrance, a waste, almost a nullity.

I have treated the subject of hospitals, civil and military, as one; always to be regarded, in fact, as but kindred institutions for the treatment of the subjects of the state in civil life, and for that of organised bodies of men, the servants of the state, as seamen and soldiers; and therefore, again, as institutions, one and the same in purport and object. They differ in the class of persons subjected to cure; and this circumstance ought to cause no other feeling in the officers employed than an honourable rivalry.

Hospitals are in some sort the measure of the civilisation of a people; they are better adapted to its wants, and better constructed, in proportion as communities are united, more humane, and more instructed. They may be regarded likewise as nature's schools, where pupils are taught her ways in diseases and casualties. As asylums for the sick and hurt, they are the most splendid expressions of wisdom and benevolence; particularly in the immediate assistance they afford to external injuries. So important, indeed, is their right management to the welfare of armies, that negligence in this respect may produce vastly more injury than twenty sanguinary battles.

Hospitals are, then, to be considered under two points of view: the first object is, to provide healthy and commodious lodging, and attendance, medical and surgical, with assistance and suitable diet; the second object is, to provide schools of instruction for students in medicine and surgery.

In an assemblage of men united into one society we shall find a certain number of poor, a certain number of sick—the one and the other being a charge upon the public. The extent and number of hospitals in a city would appear to be regulated by the amount of indigence and sickness compared to the population. But as all inhabited places are not equally healthy, nor all industrious classes equally healthy and prosperous, it sometimes happens that in populations of equal numbers there will be more poor and sick on the public charge in one place than in another; besides which, certain hospitals admit a class of sick which are not received in another. Certain towns comprise a large district, while others offer a kind of thoroughfare. These accidental circumstances render it necessary to increase hospitals, and certainly break the relation of the extent of charitable institutions to that of the populations. Add to this, that it is not known in a given number of inhabitants what is the number of the necessitous and of the sick who require charitable institutions. On this point one can only have recourse to facts drawn from the hospitals themselves, compared to the population, to the nature of the trades, especial charities, and to the position of each town; but it is of importance that we should have them collected, in order that we may be enabled to draw useful results from them; it is a work necessary to be done, to guide us with safety when it concerns the procuring an hospital for a city.

The wants of humanity are various, numerous; they claim different kinds of relief; those who receive succour from them are in different positions. It is necessary, therefore, that there should be many modes of assisting the distressed poor. There are ills which can only be treated in hspoitals; others for which houses of refuge are necessary; others, again, to whom succour can only be effectually given in their houses.

The hospital—the equivalent to the *hospitium* of the Romans, and to our own *hotel*—was, in cloisters, the place of shelter to strangers, whether rich or poor. Bearing some resemblance to our present hospitals were the public buildings for aged women of Delos, built on the island called Rheneia; and those buildings which at a later period were erected near the temple of Æsculapius for sick persons coming in search of health. It was possibly a similar institution which Antoninus built at Epidaurus. Another appears to have existed on the island of the Tiber at Rome, to which sick slaves were brought to be healed. Bethesda (house of mercy), with its five porches, was a place in Jerusalem to which the sick were brought to await the moving of the waters. Also the *Taberna Emeritorum* at Rome appears to have been an hospital for invalids.

So early as the Council of Nice, A.D. 325, hospitals are spoken of as commonly known; but the first celebrated hospital was that of Cæsarea, A.D. 370–380, richly endowed by the emperor Valerius. It was of immense dimensions. After it followed the hospital of Chrysostom at Constantinople. In the ninth century there were twenty-four hospitals in Rome alone. A foundling-hospital was established at Milan, A.D. 787; and a lazaretto about the same time in Constantinople; and an orphan-hospital in the same city, A.D. 1090, by Alexius I.

A consideration of the political, social, moral, and religious state of pagan antiquity must render it self-evident that they had not, and could not have, hospitals founded on the principle of CHARITY—a virtue of Christian origin. To Christianity solely, then, do we owe the institution of hospitals for the reception and cure of the sick; the very scattered and uncertain notices to be found in the histories of the Greeks and Romans, as of Asiatic nations, exhibiting only doubts and uncertainties. It was Christianity alone which really and practically revealed the truth that all mankind are one, and that human nature is the same in all. Christianity has not only its abasing, but its *elevating* side; and the tendency here quoted may be accepted as an essential part of the history of Christendom.

The general impression of western oriental scholars, and travellers in the East, has been that hospitals, properly so-called, never had existence in India. 'An hospital for the sick poor,' says Tennant, 'was never known in India before the British; though there were places of reception for dogs, cats, lions and other animals, but none for men;' while the stately edifices of Greece and Rome, and of other pre-Christian times, were erected for purposes other than of charity.

'Nothing,' says Mr. Raikes, 'astonished the earlier European traveller in India so much as the solicitude of the Gentoos for insect-life, and their profound indifference to human suffering—men died by the road-side, uncared for, but for bugs and fleas regular hospitals were furnished.'

It is but fair to state, however, that my friend and a brother officer of the Bengal Army, Dr. T. A. Wise,* speaking of the Buddhist religion, when at its height in Hindustan, B.C. 220, mentions the priests as establishing hospitals, in which the sick and wounded were carefully tended, by the erection of medical houses or hospitals, having depôts of medicines for the sicknesses of man, and of animals. These, the first hospitals on record, were provided with skilful physicians, having all sorts of instruments and medicines, consisting of mineral and vegetable drugs, with roots and fruits—all at the expense of the state.

On the overthrow of the Buddhist system and the restoration of that of Brahma, the former power disappeared from India with its temples and monasteries, all which were desecrated and destroyed, or converted into places of Hindoo worship; so that the duration of the improved hospitals of the Buddhists could not have been long.

General Baron Ambert says: 'Neither Greece nor Rome, great and glorious as they were, had their hospitals, whether civil or military; neither Greece nor Rome could have given birth to the Sister of Charity. Civilisation may produce heroism, which enlightens and influences; but Christianity alone can engender charity, which warms and kindles.'

Cæsar states that on the night preceding one of his battles, he ordered the sick and wounded to be conveyed to the nearest town. This precaution of removing the sick from the camp, and collecting them in a town, where they could enjoy repose and the best assistance, is surely the principle of the institution of military hospitals. Fabius, after his victory over the Veii, is said to have distributed his wounded among the nobility, who opened their houses for their reception. Severus ordered that chariots should follow the army on the march, for the conveyance of the wounded, who were subsequently placed in the charge of families, who were paid by the state for their care and outlay. These are the first ambulances on record, according to Mr. Fonblanque; who adds that, notwithstanding the soundness of the administrative system and the advantages of good roads and depôts, the Roman soldier was required to render himself as independent as possible of extraneous aid, and to carry from fifteen to thirty days' provision of grain, in addition to his armour, his weapons, his handmill and cooking-utensils, and his palisade. But, along with perfection of training in the individual soldier, there existed a great military administration—a commissariat department.

During the Crusades, and while the science of destruction had made rapid strides, that of preservation and cure had retrograded, and the unskilled devotion of individuals could do little to assuage the horrors of famine, pestilence, and the sword. Yet the example had been set of providing an asylum for the victims of war; the claims of the suffering soldier had been recognised: the virtue of humanity had been reduced to practice; and a precedent had been established, of which future generations derived the benefits. While prudence and humanity were lost in fanaticism, and only one-tenth of what was dignified by the designation of army reached its destination, it is nevertheless to this period that we may truly trace the first attempt at the establishment of what must be regarded as military hospitals. The Crusaders who escaped the dangers of battle fell victims in great numbers while performing the humblest offices of an hospital-nurse among their plague-stricken comrades.

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* *Review of the History of Medicine*, vol. ii. pp. 389, 390. 1867.

It is curious in the history of progress to observe how gradually and imperceptibly philanthropy, from being only a speculative principle — a mere sentiment or abstraction—came to be a vast power; at one time to cause the abolition of slavery, and at another to bring cheap bread to the poor man's board. The interests of society at length forced it into general acceptance; but so great a change required many centuries for its maturity. A benevolent principle is implanted in our nature, which, independently of the sense of duty, or of the approval of reason, induces us, by an involuntary motion, to relieve the distresses of our fellow-creatures, and those of our native country especially. Under the influences of a benign religion, operating upon those impulses of our nature, we perceive our country covered throughout with the most noble institutions for the sick and the distressed. Their establishment reacts favourably on the public mind. Hospitals improve the disposition of mankind by cultivating charity. A degree of dependence upon public opinion and munificence is therefore useful.

The miseries of the Crusades among the military classes, and the extension, violence and duration of leprosy among the peoples of Europe, brought about a necessity, in the middle ages, for the establishment of hospitals; and we find that Childebert, the son of Clovis, raised such establishments as the Hôtel-Dieu of Lyons, that of Paris, and of Autun, which were enlarged and improved by succeeding princes. In truth, we possess abundant practical proofs, both ancient and modern, in every country in Europe, of the interest and solicitude with which institutions have been erected for the cure of the sick poor; and the names of their founders are held in perpetual honour. It is true that in the lustre of public charities, misery, of a nature not immediately to attract the eye of pity, often remains unnoticed. But society must be content to do what can be done.*

Military surgeons are seldom mentioned in the records of our own armies in remote times. In the list of Henry V.'s army surgeons are included; but how they were entertained and paid does not appear. The disproportion between the troops employed and the persons engaged to attend to the injuries they received in action was always very remarkable. The fact was that the poorer soldiers, when seriously wounded, were discharged with a small gratuity to find their way home as best they might; a practice founded on the economical principle which prevailed as late as the sixteenth century—that 'it cost more to cure a soldier than levy a recruit.

'We cannot help wondering at the innate love of a military life, or the utter insensibility, whichever it was, that induced men to flock to the standards under such dreadful circumstances, and to spare neither life nor limb, to do to the very utmost the duty for which they had engaged.

'From numerous entries in the wardrobe accounts of Edward II., it appears that it was customary to send disabled soldiers and others in the King's service to a religious house, as to an hospital, to be there supported, either for a time, or during life. This was called 'having garrison in monastery.'†

The Hôtel-Dieu of Paris is said to date from the end of the seventh century. It is placed near the greatest temple of the capital: 'The place where the people pray, and the place where they suffer, are alike the house of God.'

The earliest notice of the establishment of an institution for the reception and cure of sick in England, is contained in the life of Lanfranc, Archbishop of

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* 'No mention is made of field-hospitals or army-surgeons in the middle age until about the fifteenth century, when field-surgeons were appointed for the use of the commanders and principal officers, but not for the service of the field-hospitals. In no part of Europe was the administration of hospitals rescued from the hands of the clergy. Even on the field of battle priests were esteemed above surgeons, if we may depend on Mochsen, who states that, by order of the first council of Ratisbon, every commander should have two bishops, with priests and chaplains, and every colonel should be attended with a confessor.' Dr. Meryon's *History of Medicine.*

† Sir S. D. Scott's *British Army.*

Canterbury, in 1070. In this building there are said to have been separate apartments for men and women. But, before the foundation of any institution having the character of hospitals, the germ of the provision now made by law for the relief of the indigent was planted by the Christian Church, in the devotion of a third of its tithes, ratified by express enactment of the Wittan, to that charitable aid which was administered by the clergy to the poor. The idea of a provision for indigence by a charge on all fixed property was of much later growth. That was a regulation of police which gave security to life, in order to protect property by suppressing vagabondage and crime.

Looking to modern times, we find that after the Reformation in England, by the dissolution of the monasteries and the consequent abolition of monastic orders, the way was happily opened to their conversion into charities, on the present system of establishment. These events unveiled all the mysterious management by which benefactions had been received and misapplied; and gave every benefactor not only the power of founding, but also of making rules for the foundation: hence these have become open to general inspection, and the intention of any benevolent donor is carefully fulfilled. The result has been, that private and public charity has become universal. The veil of humility and charity conceals an enormous amount of private benevolence; but the benevolence which is public in England is seen everywhere. In England, philanthropy may be said to be reduced to a general system, and benevolence with bounty on the largest scale are as customary as habits of business.

Many of the hospitals and 'hospices' in foreign capitals combined the functions of our English hospital with those of our Poor-Law Board, provision having been made in them not only for the cure of the sick, but also of the infirm and insane. 'The first military hospital established in Europe,' says Mr. Fonblanque, 'was erected by order of Richelieu, at Pignerole in Piedmont, where the building still exists.' The hospitals of London, as those of Paris, have been alike founded by individual charity. Not to speak of legislative and parochial systems of taxation for the support of the poor, no part of the army or navy, the church, or other establishment; not the smallest congregation for worship among the many denominations of Christians or Jews; not the smallest district or set of hamlets, unknown to the passing traveller, and too insignificant to find a place in the map; not a town or city, parish or ward throughout the United Kingdom; not a manufactory; not a corporate association, company for trade, agriculture, science, education, or medicine; not a club for the enjoyment of festivity, or the pleasures of the chase, or for the indulgence even of luxury in her various folds; not even a theatre—will be found without their respective institutions of charity, to which a willing and prompt subscription flows almost without solicitation. Thus every individual in England, according to Mr. Highmore, becomes a benefactor to others, and thereby is the greatest benefactor to himself.

We have in all this the practical proof that, in our native country, one of the first of duties is held to be to feel for man, and that the most distinguished ability and the greatest success in life are valueless when that duty is neglected.

It results from this universal diffusion of charity, that there is not a disease that can afflict human nature, nor a want which the varying condition of man can require, nor any one of the manifold visitations of adversity, in poverty or distress, but finds an open asylum, a resort ready prepared with every needful accommodation for reception, entirely free of expense.

But while our feelings are divided between wonder and admiration of the magnificent moral display of national and individual charity—the most benign of all the virtues, 'the very bond of peace and of all virtues'—we must not allow ourselves to suppose that in England benevolence has at any time been permitted to rush heedlessly at the object of its desire, unrestrained by POWER and ORDER; for far otherwise has been the fact. That which indeed graces the British capital, almost as much as its noble charities—'the memorials that renown our city'—is, the great and unquestioned character of the general administration of its public institutions. It is thus that London, in the magnificence, and in the comprehensiveness of its associations and societies, reflects the moral qualities of the United Kingdom.

In presenting the following details of construction and arrangement for hospitals, I have quoted from different sources, and most of all from the writings of Miss Nightingale, in her *Notes on Hospitals*, a work affording at once the largest and most matured experience, with the best descriptions that I am acquainted with.

In concluding her invaluable observations on 'the sanitary condition of hospitals and hospital construction,' she offers the following characteristic exhortations: 'I have here given the defects: few have had so sad or so large an experience of their results as I have had. I appeal to those who are wiser, and have more practical power than I have, for the remedies—to architects, to hospital committees, to civil and military engineers, to medical officers, to officers of health, to all men of science and benevolence, of whom our country is so justly proud. It is hard that in a country where everything is done by a despotic government, such advances in the sanitary construction of hospitals should have been made, and that our England, which ought to take the lead in everything good, should be left behind.'

I have also consulted various British and foreign authorities on the subject of hospitals, both civil and military: as Pringle, Lind, Blane, Robert Jackson, Brocklesby, Donald Monro, Aikin, Percival, Blizard, Champney, Highmore, Rollo, Stewart, Henderson, Ballingall, Lee, Wilde, Phelan, Carter and Cross, Parkes, Roberton, Walker; *Construction of Hospitals*, by Douglas Galton, C. B., General Report of the Barrack and Hospital Improvement Commission, *The Builder*, *Encyclopædia Britannica*, *N. British Review* for August 1858; *Journ. Statist. Soc. of London*; *The Charities of London*, by S. Low; Report, 1837, of Commissioners of Charities in England and Wales; Report of Commissioners on Hospitals of Dublin, 1856; Dr. William Farr on Vital Statistics, and his various sanitary reports; also the Sixth Report of the Medical Officer of the Privy Council for 1863. Of foreign authors these are the principal authorities referred to: Tenon, Recalde, Daignan, Iberti, Delaunoy, Breschet, Courtin; *Arrêts des Conseils; Rapport fait au Conseil général des Hospices*; Tardieu, *Hôpitaux et Hospices; Cours d'Administration militaire*, par M. Vauchelle; *Rapport sur Hôpitaux, Hospices, et sur la Mendicité*, par A. E. Cerfbère.

SITE AND CONSTRUCTION.

If it be undisputed that hospitals may be made to render great services to the public health, it is equally so that the nature and amount of such services must depend on the rigour with which we attend to their sites, construction, and administration. The site should be of established healthiness, having nothing to prevent free circulation of air all around; the ground should be free from impurities, and from surface moisture, the natural drainage being sufficient and available; never receiving the drainage of higher grounds. The Chirurgical Society of Paris proposed in 1864 that no hospital should stand on less space of clear ground than 540 feet to each patient; so that an institution for 80 patients should, at the least, stand on the centre of an acre of ground—the proportional area to increase with the number of patients.

Here it may be observed, as to construction, that the ward is the true and only foundation of the hospital; once given a perfect ward, and we have but to multiply it, upon a proper soil, and a sufficient area, and the hospital is complete. In our older histories we find terrible examples of the destruction of health and loss of life caused by neglect in these essentials.

Hospitals, in common with all public buildings—in common, indeed, even with the towns and cities in which they may be placed—are, to their inmates, but places of reception and accommodation of the day, for the purposes of the day, and exhibiting in their structural arrangements the ignorances of the day: to give place, however, in due time, and as observation guided by science may dictate, to other and more perfect structures. It is but the natural progress in science and skill. We see it, in fact, in operation throughout London at this very day, and in every hour of every day.

If we had carefully considered the nature of man in health and in disease, along with his various requirements under each condition, our hospital-wards and our barrack-rooms would not have been constructed like an hotel, having room within room, on principles purely arbitrary, or on no principles at all.

'It should never be forgotten for a moment,' says Miss Nightingale, 'that on the purity of the air of a ward depend, in a great measure, the recovery or death of the sick and maimed, the usefulness or injury arising from the hospital, the duration of cases, and, consequently, the hospital economy; whether, in short, an hospital, planned, erected, and supported "by voluntary contributions," is to be a blessing or a curse to civilisation.* And when we consider that a man cannot forego this supply of air so many minutes as he can forego food for days, is it a subject for wonder that pure air should be the main condition, as of health, so of recovery?'

The desideratum to be determined by sanitary and architectural science is this: can we, by a proper selection of site, and by proper structural arrangements, rescue the inmates of our great hospitals of the United Kingdom from a mortality, which, according to Miss Nightingale, ranges from 'four and a half per cent to nearly sixteen per cent.' These averages are reckoned *on the cases treated.*

On the geometrical dispositions of the architect depend, not only the renewal of air, so indispensable to an hospital, but in a great measure its interior police, the regularity and promptness of the service. With simple forms of distribution adapted to the wants of hospitals, nothing escapes supervision; in one *coup d'œil* we embrace the service and the sick, while we secure care and exactness in the performance of duty.

The following principles of construction are presented as the best hitherto discovered:

1. That no hospital shall consist at most of more than two stories in height.

2. That by this arrangement the sick are spread over a wider area, the walls not being so high as to interfere with the ventilation and sunlight of neighbouring pavilions; while the accumulation of hospital miasm in the upper floors is avoided.

3. That the construction by two stories facilitates the access to the wards by patients and attendants, and the whole administration is rendered easy.

4. All the most approved hospitals on the Continent, as the Lariboisière of Paris, are built in as many as three flats; and it would there be esteemed nothing short of breach of trust to erect lofty and massive buildings within a crowded city.†

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* Ponteau, looking at the ill-placed, ill-constructed, and ill-regulated hospitals of his day, asks: 'Are hospitals, then, more pernicious than useful to society?'

† Miss Nightingale says—'There should not be more than two floors of wards to the block. The most healthy hospitals have been those on one floor only: and this because they require less scientific knowledge and practical care in ventilation. If another floor is added, a community of ventilation exists between the ward below and the ward above the common staircase, and by filtration of air upwards through the floor. The risk from this can be diminished by constant care in the use of doors and windows, and by introducing impervious floors. But, unfortunately, systematic care in these matters is not to be looked for, especially that constant supervision necessary to keep the ventilation of three or more floors of wards quite independent of each other [whoever sees this even in private houses, when there is an invalid?], and hence there is a strong conviction in the minds of careful hospital physicians, surgeons, and nurses, that patients do not recover so well upon upper floors. Moreover, the *sick population* requires more surface for health than a healthy population; and it is clear that if patients are placed on three floors instead of two, the surface over-crowding is increased by one-third, unless the distance between the pavilions is increased in a corresponding ratio. But the general administration of lofty hospitals is also far more difficult and fatiguing than those of moderate height. Any increase of distance between the

5. In constructing wards, they should be so built as to be flooded with sunlight, and the windows should bear a large proportion to the wall-space of the hospital. Experience proves that window-space ought not to be in a much less proportion to wall-space of an hospital than one to two.

6. The free admission of light has everywhere been proved beneficial to health and conducive to cheerfulness; while, as often observed in ill-constructed barracks and hospitals, the exclusion of light has proved detrimental to health directly, and also by retarding convalescence.

7. The best principle of hospital construction is that of separate pavilions placed side by side, or in line. The former is very preferable for large hospitals, for the reasons already stated; and there should be but two flats in a pavilion, and one ward to a flat. Pavilions are, in fact, separate hospitals, having a limited number of sick under one roof.

8. The form of the hospital should be an oblong square, the basement story of the pavilions being connected by a corridor, and the whole of the basement erected on arches. The pavilion plan is generally received on the Continent as the sanitary necessity for hospital construction.

9. It is undesirable to increase the width of any ward beyond thirty feet, because the distance between the opposite windows becomes then too great for efficient ventilation.

10. Windows should be double, or glazed with plate-glass, to prevent loss of heat. Tripartite windows, like those of the Middlesex Hospital, are useful for ventilation.

11. The ward-walls should consist of pure white Parian cement, or some equally white non-absorbent substance. Grey-coloured cements should be avoided; they never look clean, and they give the ward a sombre appearance, and hide dirt.

12. The best ward-flooring is oak; and the joints of the flooring should be well fitted together, so as to be impervious.

13. No sawdust, or other organic matter capable of rotting, should be placed underneath hospital floors.

14. Floors should be bees-waxed, or oiled and polished.

15. The general baths of the hospital should be separated from the pavilions, but connected with the corridor. They should contain hot and cold water, medicated, sulphurous, Turkish, vapour, shower, and *douche* baths.

16. The kitchen should have walls and ceiling of Parian cement, or other such material.

17. There should be a head-nurse's room and scullery attached to each ward, and store-presses outside the wards.

18. Bedsteads should be of iron, and be supplied with hair-mattresses. The ward furniture should be of oak. Whether regarded as a means for securing sleep, rest, muscular relaxation, or repose, the bed is a direct auxiliary to the cure, and too much care cannot be given to its construction and situation.

19. The ward construction now described is that which, up to the present time, experience has shown to be best suited for fulfilling all the requirements of ventilation, light, cheerfulness, recovery of health, and economy, in this country.

20. One great advantage of the proposed system is, that it admits of any arrangement of the pavilions on a plan which is consistent with light and ventilation. Hospital establishments so constructed may be added to without difficulty and without altering, or indeed without interfering with any of the existing pavilion buildings.

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pavilions will add to the difficulty, and both difficulty and fatigue are very important considerations for efficiency and economy in this branch. To sum up—hospitals on one floor require least care; those on two floors can be kept healthy with moderate average care. Beyond this, care, intelligence and fatigue, such as are rarely likely to be bestowed, are essential to maintain a moderate amount of health, among either wards or nurses.'

21. The principles of hospital construction here advocated are at variance with those of almost all the old hospitals of the three kingdoms; but the whole question, in all its importance, is in the hands of the profession and of the public; and observation, experience, and free discussion, will ere long determine what is just and true.

22. Most of the great hospitals and charitable institutions of this country were suburban at their foundation; the rapid growth of our towns in modern times has encroached so much upon space once country, that gardens and fields have been absorbed, and are now covered with bricks and mortar; and hospitals are surrounded by the screaming and roaring traffic of railways, street-cabs, omnibuses, and wagons.

23. It is due to the founders of our great charitable institutions that their humane intentions should continue to be realised by removing the sick and maimed to pure air and quiet. It is due to poor suffering humanity that any plans adopted should be the most perfect which modern intellect can devise; and it is no less due to the cause of charity that there should be the best and most economical form of hospital nursing and management.

24. I have here confined myself to a consideration of the best-known plans of hospital-construction, believing that a review of second- and third-rate plans is but waste of time. In crowded cities we must be satisfied with what can be done; but I feel assured that, wherever practicable, such plan and arrangement as those of Miss Nightingale will in the end prove the cheapest, whatever the price of ground may be.

The following is a brief summary of the principles of hospital-construction here recommended:

(*a*) Never erect a general hospital within the precincts of a town, or in suburbs likely to be built upon.

(*b*) Remove all general hospital establishments out of town, and from populous suburbs, as soon as circumstances may permit; or, when such removal is not practicable, let all the available ground around the institution be purchased.

(*c*) Build all general hospitals in the country on areas of ground sufficient to admit of extensions of buildings, and to prevent other buildings from being erected within such a distance as shall interfere with a free circulation of air and with quiet.

(*d*) Select a mild and dry climate.

(*e*) Give the preference to a porous self-draining subsoil, and avoid ground saturated with organic matter, especially old graveyards.

(*f*) Build all hospitals on arches, to admit of a free circulation of air underneath the ward floors.

(*g*) Let the plan be simple, and have as few closed angles and corners as possible.

(*h*) Do not provide for more than 120 patients or beds under one double pavilion roof. If the hospital must contain a larger number of beds, increase the number of pavilions by corridors running between the ends, and no higher than the ground-floor.

(*i*) Plan any hospital with no more than two flats, containing, in a single pavilion, two super-imposed wards. Provide for convalescents and 'casualty' cases in pavilions separate from the ordinary sick.

(*j*) Provide for no more than 32 beds in a ward (16 on each side), with a window to every two beds.

(*k*) Let the window-spaces be, as near as may be, in the proportion of one to two of the wall-space. The windows should reach from within three feet of the floor to within one foot of the ceiling.

(*l*) Wards should not exceed 30 feet in width. The construction of a small ward may be sanctioned only for the separation of very bad cases, or for the reception of cases of extraordinary severity.

(*m*) Each bed should have from 1,500 to 2,000 cubic feet of air-space. In very exposed and airy situations, the smaller cubic space will suffice; but where, from the nature of the ground, there is not likely to be much horizontal external movement of the atmosphere, the larger the internal cubic space is the better. In our temperate climate 90 square feet per bed may be taken as a fair average for its superficial area; while this space must be increased where the site is faulty, or where a Medical School has to be provided for. One hundred and twelve feet are considered necessary for purposes of nursing and teaching. The entire space resulting from these conditions, where, as in the Herbert Hospital, the height of the ward is 14 feet, may, according to some authorities, be allowed to range so low as 1,260 cubic feet.

(*n*) Trust for pavilion ventilation to open windows and fire-places. Artificial methods are in this climate unnecessary, with proper construction.

(*o*) Place water-closets, ward-baths, and lavatories at the far-end of a ward, opposite the entrance; and, in addition to ventilating them, cut them entirely off from the ward by a separately-ventilated and lighted lobby.

(*p*) Restrict the ward-offices to a nurse's-room and scullery, with a lift.

(*q*) Let staircases be wide, roomy, and thoroughly ventilated up to the roof. Construct the stairs and entrance and entrance-lobbies of stone, and cover them with wood.

(*r*) Make hospital floors of oak, and the walls and ceilings of pure white polished cement.

(*s*) Supply hospitals with water at high-pressure, and lay it on, hot and cold, over the whole of the buildings.

(*t*) All sewers and drains must be outside, and detached from the walls of the buildings. Provide for their ventilation at a distance from the wards, and also for their inspection and flushing.

(*u*) Provide garden-ground for exercise, with properly drained and gravelled walks, sheltered seats for convalescents, and, where practicable, a promenade covered with glass, for bad weather.

(*v*) Other matters of detail, regarding kitchens, wash-houses, rooms for hospital administration, &c. can be best decided on according to local circumstances; but none of these should ever be under the same roof with the sick.

25. Starting with the principle that the very first requirement in an hospital is that it should do the sick no harm, Miss Nightingale states that the conditions essential to the health of hospitals are principally these: first, fresh air; second, light; third, atmosphere; fourth, subdivision of sick into separate buildings or pavilions. Let us examine the causes in the usual ward-construction which prevent us from obtaining these and other necessary conditions. The principal are as follows:

(*a*) Defective means of natural ventilation and warming.

(*b*) Defective height of wards.

(*c*) Excessive width of wards between the opposite windows. The width of the wards in the Herbert Hospital is 26 feet; that in St. Thomas's 28 feet; in the new Hôtel-Dieu 29 feet; the two last-named being, however, great medical schools.

(*d*) Arranging the beds along the dead walls.

(*e*) Having more than two rows of beds between the opposite windows.

(*f*) Having windows only on one side, or having a closed corridor connecting the wards.

(*g*) Using absorbent materials for walls and ceilings, and, as some will have it, washing floors of hospitals.

(*h*) Defective condition of water-closets.

(*i*) Defective ward furniture.

(*j*) Defective accommodation for nursing and discipline.

(*k*) Defective hospital kitchens.

(*l*) Defective hospital laundries.

(*m*) Selection of bad sites and bad local climates for hospitals.

(*n*) Defects of sewerage.

(*o*) Construction of hospitals without free circulation of external air.

26. The most approved observations and experiences have sufficiently demonstrated that one floor is enough for convenience of the sick and for pur-

poses of attendance; and that more than two floors will generally prove prejudicial in many important ways. The principles of construction which apply in the climates of Europe, are generally suitable to those of India. But I believe that one-storied hospitals, built on arches, and having double roofs, will be found best for the plains of Hindustan; while the huts of the country, or iron huts having the country thatched roofs, will prove more convenient and useful for the mountain climates; besides being, out of all comparison, less costly.

27. In our garrison and regimental hospitals at home we generally find an extraordinary number of wards, and of holes and corners, in comparison with the number of sick. In a battalion-hospital, for instance, we shall find eight or ten little bed-rooms (miscalled wards), a little kitchen; everything, in fact, on a little scale, like a collapsed French hospital. How much more sensible would it be to have one, or at most two, large wards for thirty to forty sick each, with a small casualty ward; how much less costly in construction and administration, how much easier the supervision and discipline, how much better the ventilation.

28. 'The least administrative form of hospital,' says Miss Nightingale, 'is the long corridor, with wards of from eight to ten patients, opening off one side. Attendance — meaning, of course, due attention to the patients, suitably superintended—becomes almost impossible, especially at night.'

29. Whatever the cause of injury to the sick or wounded placed in hospital, the truth and value of the following observation, by the same authority, will be recognised by all who are acquainted with hospitals, whether civil or military: 'One insensibly allies together restlessness, languor, feverishness, and general *malaise*, with closeness of wards, defective ventilation, defective structure, bad architecture and administrative arrangements, until it is impossible to resist the conviction that the sick are suffering from something quite other than the disease inscribed on their bed-ticket; and enquiry insensibly arises in the mind—what can be the cause? . . . I have seen a case of slight fever received into hospital; the fever to pass off in a week, and yet the patient, from the foul state of the wards, not restored to health at the end of eight weeks.'

30. 'It is impossible to ventilate a ward in a brick or stone hospital by natural means, when the cubic space is less than a certain amount. Crowded wards are, in fact, offensive with all the windows open.'

31. 'The cooking-apparatus, boilers, &c., if placed in the centre of the kitchen, instead of against the walls, will afford twice the amount of fire-space.'

32. 'In the Paris kitchens there is a brick erection in the middle of the floor, with iron doors and brass mountings, coppers with covers, places for baking and roasting, &c.'

33. 'The dressers are against the walls; the floors are flagged with square flags. This appears to be the most convenient mode of erection.'

37. 'But it is not so well known that there was but lately scarcely an army hospital which had such a thing as a laundry. The bedding was generally washed by the barrack department; no one appeared to know how. It was done by contract.'

39. 'A great deal has been said about the communication of "infectious" disease, both in civil and military hospitals, from patients' linen to washerwomen. . . . Let laundries be constructed with sufficient area and cubic space for each washer, with abundance of water, with proper means of drainage, and ventilation for removing the vapour, and with properly constructed drying and ironing rooms, and we shall cease to hear of washerwomen "catching fever."'

40. 'But every day brings in fresh inventions, and the reformer is always adopting the good ones. The excellent washing, drying, and wringing machines lately invented, are too numerous to mention; but on the whole, the laundry at Wellington-barracks, which also washes for all the Guards' hospitals and barracks, and the new laundry at Haslar Hospital, are the best I have seen.'

41. 'I do not think that any reliable comparison has yet been made between the French system adopted at the Salpêtrière and Lariboisière hospitals and the English system. The French consists in filtering hot ley through the clothes, which are placed for that purpose in large tubs, with a compartment at the bottom from which the ley is pumped up by machinery, and allowed to flow over the top to the linen, through which it filters into the compartment, to be again raised by the machine. This plan is stated to be the most economical which has been tried in Paris.'

42. 'There are several good plans in use in British hospitals. The essential characteristic of the Haslar one is boiling by steam, the linen being afterwards placed in a rotating washing machine.'

43. 'Another method in use at the Wellington-barracks, where the washing of the Guards' barracks and hospital is done, consists in passing the linen through slowly rotating washing-tubs, in which it undergoes a process of waulking by wooden rods. This plan is both economical and effectual.'

44. 'In almost all the military hospitals in England, it is true, the heavy washing is done, nobody knows how, by contract. But the lighter washing is done in some miserable lean-to, without any arrangement for "getting-up," drying, or airing the linen, which is done, if at all, at the ward fire. This is simply destruction to anything which can be called nursing.'

45. 'The baths should be separated from the pavilions, but connected by the corridor.'

48. 'A small bath-room for bad cases should be placed adjoining to the water-closets, and also a lavatory.'

49. 'A lavatory should have a row of white earthenware basins fixed in a stand, with outlet tubes and plugs; each basin should have a hot- and cold-water pipe, and there should not be less than one to each six or eight beds. There should also be in the lavatory a hot- and cold-water pipe, from which the portable bath can be filled.'

50. 'A scullery—small, but not too small—attached to each ward is, as has been said, essential to order, cleanliness, and discipline. It should be well provided with cold, and if possible, with hot water. No patient should enter the scullery unless sent there to wash-up, &c.; and, as a rule, none should be sent there.'

51. 'The sink, which should have a partition of its own, adjoining the water-closet, should be a high, deep, large, round, pierced basin of earthenware, above a large hole, with a cock extending far enough over the sink for the stream of water to fall directly into the vessel to be cleansed. This is far preferable to the usual oblong sink.'

52. 'The scullery sink is of course to be entirely separate, and for entirely separate purposes from this.'

53. 'In civil hospitals, each nurse should have a small airy room off her ward, and looking into it, so that she can always have it under her command: it is the best for her efficiency, and need not be injurious to her health.'

54. 'Unless, however, there are facile means of access to another nurse's room, in case of illness, there must be only a day-room for each head-nurse adjacent to her ward. She must sleep at a distance from her ward, and contiguous to the other nurses.'

55. 'Assistant female nurses are better not employed.'

56. 'In military hospitals, if orderlies are to sleep among their patients, the percentage of mortality will be of course raised among them. This was the case at Scutari, where it was very high, though it will never be known how high.'

57. 'Statistics are, however, not necessary to establish such an obvious fact. The orderlies should sleep at a distance from the wards, or, if sanctioned by military authority, in little rooms adjoining their wards, and they should not take their meals with the patients.'

58. 'Each orderly should have his locker, each his safe in it, with a key of his own, and he should have his meals there, if the military authorities are not against it.'

59. 'There should be a press in each ward.'

60. 'It is a doubtful arrangement to have a clothes-room for each ward. A military hospital should have but one clothes-room, under charge of some man.'

61. 'Room for storing and issuing dried clean linen, as well as laundry-room, should be provided. Foul linen should be delivered twice daily into the laundry; and a large box in the scullery is the least bad place for it in the mean time.'

62. 'The material of the different utensils required for ward service should be settled. The use of glass or earthenware for all eating, drinking, and washing vessels is recommended for its great superiority in cleanliness, and in saving time and labour in cleaning. Tin vessels of certain kinds cannot, by any amount of cleaning, be freed from smell.'

63. Recent discussions have imparted much interest to the question of site, especially in connection with the wants of city populations.

(*a*) Could sanitary considerations alone rule in this matter, doubtless we should have all hospitals placed in the open country, as near as might conveniently be to our towns and cities but away from masses of buildings and from dense populations.

(*b*) But there are other considerations, as the immediate wants and conveniences, the absolute necessities indeed of the poor, which must here be practically met. We must, under such overruling influences, be content to do what can be done.

(*c*) All physicians and surgeons will agree that the more open, airy, and pure the site of an hospital, the better for its inmates; but here, as in many other social conditions, we have in fact to deal with the necessities of civilised communities, and we must have certain hospitals of immediate necessity placed within crowded cities.

(*d*) But while this fact is admitted, as the result of necessity, we ought everywhere to establish convalescent hospitals, supplementary to, and co-operative with, the central institutions.

(*e*) But we must remember also that in the perfection of structure, as regards facilities for ventilation and drainage, and in care as to the cubic space allotted to each patient, will everywhere be found the best securities against errors and deficiencies in respect of localities, whether in town or country.

(*f*) Strange to say, we have in the hospital Lariboisière an example of a structure of unequalled excellence, with a good town site, all rendered unsuitable, and consequently unhealthy, by a perversion of arrangement. Lariboisière was constructed for natural ventilation, but this was not deemed sufficient; so, pure air has been denied to the patients, and a heated and impure air has been forced into the wards to stifle and sicken them, and to augment their mortality.

(*g*) It is conduct such as this, in discharge of a public trust, which gives colour to and occasion for the suggestion of Ponteau, above quoted: 'Are hospitals, then, more pernicious than useful to society?'

(*h*) One circumstance has been much overlooked in discussions as to the construction of hospitals, and of their usefulness—namely, that the disadvantages of massing sick in very large apartments, however unsuitable on various accounts, and in many cases, bear no comparison with those which are always encountered in the miserable habitations of the poor, both in town and country;—the fact being that many of the defects of even the worst hospitals may be in great part remedied by means of ventilation, and by providing day-wards, and by the establishment of convalescent hospitals.

Lastly. The convenience of the patient must be a point of first consideration, so as that the hospital may be completely accessible to the ailing, the diseased, and the maimed amongst the poor; so as to secure also to them the services of physicians and surgeons in large private practice, thus assuring at the same time the best medical science from the heads of the profession, together with the best means for the establishment of great medical schools.

Postscript.—The idea of a perfect hospital would imply, generally, an elevated site and pure dry soil, the building being constructed on an open space, and consisting of one story placed on arches, so as to secure the free play of air between the ground-surface and the floor of the wards; but on low grounds, and in marshy countries, a second floor has its advantages, as affording a more healthy sleeping accommodation. In no country should an hospital exceed two stories.

It were a serious error, therefore, to suppose that an hospital could by itself be so constructed as to prove everywhere sufficient; structural perfection being in reality but one of the requirements of the case. There must be, in aid of structure, works of general and sub-soil drainage, a pure-water supply, and an improved agriculture. These considerations become of greatly increased force in tropical climates.

VENTILATION, LIGHT, AND CUBIC SPACE.

1. The first and most important consideration in constructing and arranging hospitals is to secure a free supply of pure air outside and inside the building.

2. The air must be moving air in mass. Plan the building, therefore, so as that the sun-light may strike as large a surface of it as possible, and so that the air may move freely over the whole external surface.

3. In Scripture the atmosphere is termed 'the breath of life,' as indicating the vital properties of pure air. So life-giving is pure air, indeed, that we must have it in excess of our actual wants, if we would insure that what we are inhaling may not be corrupted by the consumed air which we have exhaled; for be it remembered, that no kind of impurity of air is more injurious to health than the impurity of air expelled from the lungs. Ample cubic air-space is both important and necessary; but it alone will nowhere prove sufficient for health, without provision for the constant removal of the exhalations from the lungs and skin of the sick.

4. For thousands of years the natives of India have regarded purity of skin as obtainable only through the rinse of the river stream, or through the imitation of it in the bath-room by a constant stream of clear water poured from a vessel —the same water not applying to the skin twice. If we would enjoy a perfect respiration, with consequent purity of the blood, we must secure the same kind of rinsing or cleansing, by a constantly succeeding supply of pure air for the supply of the lungs. In the eagerness of some persons to plunge into and appropriate all degrees of cubic space, they forget that the degree of purity of an apartment must depend not upon its size or space, in fact, but solely and exclusively—1st, on the rate at which emanations are produced; and, 2ndly, on the rate at which fresh air is admitted. Space is in truth of importance in so far as it admits of the introduction of air without the production of draughts, but even this advantage has its alloy in the difficulty of warming very spacious rooms. There must be supplied to every ward a means sufficient to warm the air to the proper degree.

5. The motion of the air in any room should never exceed the velocity of two feet and a half per minute, and it should not at any time be much below this rate.

6. There must be no stagnation. A court, with high walls round it, does one thing with certainty—it stagnates the air, and renders it unfit for respiration.

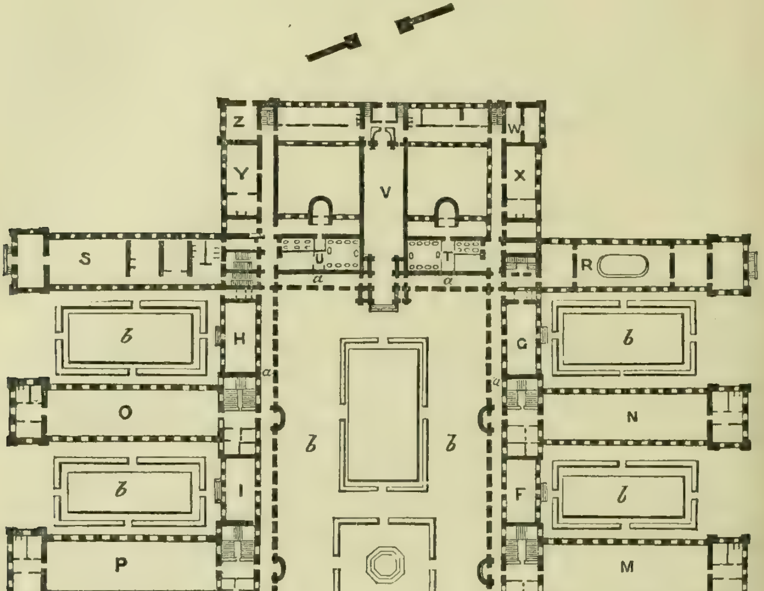
7. All closed courts, narrow *culs-de-sac*, high adjacent walls, closed angles, over-shadowing trees, and other obstructions to outer ventilation, should be sedulously avoided, at whatever cost.

8. There are certain arrangements of buildings at present occupied for hospital purposes which ought to be carefully avoided, whether in town or country.

9. It may be considered certain, that wherever such arrangements exist, injury to the sick is so constant that, were it practicable, all the angles should be opened out, in order to admit the free circulation of air.

10. The most simple form of structure for insuring ventilation and light is to build hospital wards in a straight line, with windows on both sides, i.e. back and

Fig. 428.



Hospital of Lariboisière, Paris, 612 beds.

A Offices.
B Kitchen on the ground floor. On the 1st floor, lodgings of the officers; on the 2nd floor, dormitories for male attendants.
C On the ground floor, pharmacy; on the 1st floor, lodgings of the officers; on the 2nd floor, rooms of the resident pupils.
D E F G H I J K Dining-rooms, &c., one story high, now disused as such.
L M N O P Q Buildings for the sick, three stories high.
R Ground floor, wash-house; on the 1st floor, linen store; 2nd floor, dormitories for female attendants.
S Sisters' Rooms. T U Baths. V Chapel.
X Y Ampitheatre.
Z Manège and stores.
W Stable and dead-house.
a a a a Corridor one story high, with open terrace above, running round the buildings, and connecting them.
b b b Gardens.

front—the lengthway of the ward being the lengthway of the building, and the administration in the centre.

11. By such an arrangement as the above, however, no more than four wards could be obtained, if the building were two stories high. For small hospitals, intended only to receive 120 sick, this plan will prove efficient and economical.

12. The direction of the axis of such a building should be from north to south, a little inclined to the east, so as to secure the sunshine on both sides every day of the year, and to protect the wards from the NE. winds.

13. One staircase will suffice for an hospital such as this: and if it were carried from the bottom to the top of the building, and ventilated above the roof, it would entirely cut off one set of wards from the other, and thus prevent the possibility of any intermingling of foul air.

14. A much better arrangement is that in which the wings are entirely detached from the centre, and connected with it only by an open corridor on the lower floor. This is the plan adopted in the great military hospital at Vincennes, and is a very good one for hospitals of a certain size, for the open angles permit air to circulate freely round the building. All these plans, however, have the disadvantage of not admitting extension beyond a certain limit.

15. The only plan which allows as much extension as can be necessary in any single hospital, up to (say) a thousand sick—beyond which hospital management becomes very difficult—is the plan adopted in the hospital of Bourdeaux; or, still better, that of the Lariboisière at Paris, of which the plan will be found on the preceding page.

16. In that fine, though not perfect, hospital, each block, containing 102 sick, constitutes a separate hospital. There are six of these blocks, which are arranged parallel to each other on two opposite sides of a square; and there are four blocks containing the administration and other offices.

17. All the blocks are joined together by a glazed corridor along the lower floor, and by an open terrace above, for convalescents taking exercise. In such a building, for the sake of sunlight, the axis of the wards should run nearly from north to south, and the distance of the blocks from each other should be about twice the height of the side walls.

18. As regards immediate ventilation, the important considerations are—the quantity of air required in an hospital, and how best to renew it.

19. To make ventilation equable and agreeable, the windows and other apertures must be directly opposite to each other, of the same dimensions, so as to admit and emit an equal volume of air, through an equally free communication with the external atmosphere. Inattention to this simple rule has often defeated arrangements otherwise excellent.

20. Oil-lamps are to be preferred for lighting of wards, as gas produces glare, and is apt, through defects in the pipes and burners, to leak into the ward.

21. The great and constant movements going on in the atmosphere prove that the amount of change which nature has provided for healthy existence is unlimited. The test of ventilation in a sick ward is the comparative freshness or impurity of the air. The interesting experiment of Lariboisière appears to prove that about 4,000 cubic feet per hour are required to insure this.

22. There are two ways of maintaining the freshness of a ward: First, by so constructing a building that Nature will renew the air, if left to herself, which is by far the best plan; secondly, by artifical ventilation—never to be used except as a *pis aller*.

23. If an hospital be badly planned, or the fuel dear, artificial ventilation comes into beneficial operation, for it admits of economical warming; but it never *freshens* a ward like pure natural air from without.

24. It is quite certain that a condition of ward-air is secured by open windows, and by open fire-places for warming, which is never obtained by the best ventilating machinery, especially if warm air be thrown in by it. Every observant medical officer and nurse knows this: the air from without is better oxygenated, and perhaps contains more ozone.

25. Architects must therefore well consider how in every corner of wards, passages, and staircases, air is to be kept constantly *flowing*—not air passing in a stray or in a strong current, but air gently moving.

26. Wards must be made of a certain height and breadth, having a window for every two beds, the windows being exactly opposite to each other. As regards complete ventilation, the effect of angles in retarding an even flow of air has not been sufficiently considered. Direct experiment, made in the wards of the Lariboisière, has proved that the amount of air circulating along the centre of a ward is two or three times as great as near angles.

27. Such a result might have been inferred. But the important practical point seems never to have been comprehended, that the difficulty of ventilating a given cubic space, occupied by sick, bears a direct ratio to the length of the corridor, and to the number of wards into which that space is divided.

28. Unnecessary rooms, angles, or cupboards, should be omitted; there should be no dark corners in any part of an hospital ward; every recess or angle not easily overlooked, being as injurious to hospital discipline as it is to hospital ventilation. Transverse or horizontal ventilation may be rendered perfect by the means already indicated; but in seasons of protracted calms, in the heats of summer and autumn, and in tropical climates, means should be prepared for securing vertical ventilation, by means of turrets in the roofs of hospitals and barracks.

29. Each pavilion should have a staircase, wide, roomy, well lighted and ventilated from above; the gradients of the steps not rising above five inches to twelve inches tread, in order that patients may ascend and descend with facility.

30. There should be as little passage-space as possible, and none of it should be dark.

31. Architects have not sufficiently appreciated the great difference between the air-wants of wards constantly occupied by sick and wounded, and those of apartments used as dormitories during so many hours only, by persons in health, and that a provision which may be sufficient for the one falls far short of the necessities of the other.

32. Mr. Roberton of Manchester, in his excellent reports on the 'Construction and Ventilation of Hospitals,' assures us that the insalubrity of our hospitals arises mainly from two causes: first, the difficulty, owing to faulty construction, of securing a free circulation through the wards, and continued renewal therein of the external atmosphere; and, secondly, the intimate connection existing between the different wards in each story, by means of doors and passages, and between the different stories by inside stairs—an arrangement which favours the rapid diffusion over the house of the foul air continually being generated in every one of the wards, and the creation consequently of an hospital miasm.

33. But all the evils of defective ventilation were well known to our older hospital staff, civil and military, and are admirably described by Pringle, Cullen, Lind, Rush, Robert Jackson, Smith, &c. &c.

34. In remarks concerning circumstances of distress not within the provisions of hospitals, with the regulations of the Samaritan Society, instituted in London in 1791, we find the following observations:

35. 'The air may have its purity, and consequently its uses, affected in several ways: by what diminishes its immediate fitness for respiration; by what lessens its capacity to receive in due quantity that which is excreted from the lungs and skin; by what destroys, or abridges, that which should be received by the absorbents of the lungs and skin; and by what, in its own nature, would prove noxious, if absorbed. In these ways also various combinations of mischief may arise.'

36. 'To the last distinction animal effluvia must be referred. But infinite are the depravations of the air, under the heads stated, graduating, from the slighest degree of each, up to the power of producing death instantaneously.'

37. 'Attention being paid to the cardinal object, AIR, hospitals possess advantages, adapted to the condition of sick and hurt persons, superior to what

can be equalled by many situations in life. Informed persons should, therefore, discourage the prejudices that are sometimes entertained by the lower orders against these establishments; in support of which they will not unfrequently resort to invention.'

38. Dr. Percival of Manchester, writing to Mr. Aikin, in 1771, says: 'AIR, DIET AND MEDICINE, are the three great agents to be employed in preventing and correcting putrefaction and contagion in hospitals.' There he rates medicine as the third power.

39. Pringle declares that 'air corrupted by putrefaction is, of all other causes of sickness, the most fatal, and least understood; for these destructive steams work like a ferment, and ripen all distempers into a putrid and malignant nature. But the air in hospitals and crowded barracks, close transport-ships, and in a word, from every place where air is so pent up, not only loses a part of its vital principle by frequent respiration, but also is corrupted by the perspirable matter of the body, which, as it is the most volatile part of the humours, is also the most putrescent; hence it is that, in proportion to the nastiness of such places, to the number of dysenteries, and of foul sores, but above all, of mortifications, a malignant fever is both frequent and fatal.'

40. The instructions of Donald Monro, the army surgeon, for the ventilation, cleanliness, and order of the military hospitals of his day (1760–1780), would do honour to any medical officer of our time; and Brocklesby (1756-1763), speaking of his experiences in preserving the health of seamen and soldiers, distinguishes 'above all things fresh air.'

41. As regards the general principles, and the need for ventilation, there is nothing whatever known to us, in the middle of the nineteenth century, which was not well understood by Pringle, Monro, and Brocklesby, in the middle of the eighteenth century. The real difference in our favour is in the aid we derive, practically, from the influence of public opinion, and from the power of the press which represents it.

42. Dr. Rollo of the Artillery states (1801) the following points as necessary in an hospital:

(1) A free ventilation and regular temperature.

(2) Ready means of cleanliness.

(3) Amusements for patients, by giving them airy and gay prospects, with pleasure-grounds.

(4) A ready means for separation of the sick, and for preventing the spreading or progress of infectious diseases.

He adds that 'cleanliness of the patient, and of everything about him, is indispensable. This and ventilation are the two first and most essential objects in hospital management.'

43. To illustrate his subject, Dr. Rollo says that, in 1789, several men of the artillery at Woolwich were seized with a severe form of continued and relapsing fever. These men were found to have occupied beds 'different from the rest of the barracks, having hammock-bedding. The hammocks were rolled up tightly every morning the moment the men rose, and they were unloosed when they went into them at night; and this time we had so much and so constant rain, that this bedding had not been aired, or opened for a single day, for at least two months. The hammocks were with their bedding examined, and the moment they were opened a very peculiar nauseating smell was perceptible. Steps were immediately taken, and no further mischief took place. Here an infectious fever evidently arose from the confinement of the effluvia of a man's own person, in a time of about two months.'

44. Having explained thus far the principles and practice of ventilation as applicable to hospitals, I would add a few observations on LIGHT—a subject of the greatest importance, but one surprisingly neglected by all classes of our teachers, whether lay or professional.

45. Of all the elements which play a high part in the material universe, the light which emanates from the sun is certainly the most remarkable, whether we view it in its sanitary or scientific relations. It is, to speak metaphorically,

the very life-blood of nature, without which everything material would fade and perish.

46. 'It is well known,' says Dr. Priestley, 'that *without light* no plant can thrive; and if it do grow at all in the dark, it is always *white*, and in all other respects in a sick and weakly state.'

47. But the direct influence of light over the phenomena of life will not be found limited to the vegetable kingdom, or to the lower races of the animal world. Organisation and life exist only at the surface of our planet, and under the influence of light. Vegetables and animals near the surface of the sea are brilliantly coloured; but they gradually lose the brightness of their hue as they descend, until the animals of the lowest zone are found to be nearly colourless. Those depths of the ocean at which an everlasting darkness prevails are the regions of silence and eternal death.

48. Man in his most perfect type is doubtless to be found in the regions of the globe where the solar influences of light, heat, and chemical rays are so nicely balanced. Under the scorching heat of the tropics man cannot call into exercise his highest powers. The calorific rays are all-powerful there, and lassitude of body and immaturity of mind are its necessary results; while in the darkness of the Polar regions the distinctive characters of our species almost disappear, in the absence of those solar influences which are so powerful in the organic world.

49. Dr. Edwards maintains, however, that in climates in which nudity is not incompatible with health the exposure of the whole surface of the body to light will be very favourable to the regular conformation of the body; and Baron Humboldt affirms of the Chagmas that 'both men and women are very muscular; their forms are fleshy and rounded. It is needless to add that I have not seen *a single individual with a natural deformity.* I can say the same of thousands of Caribs, Muyscas, and Mexican and Peruvian Indians, whom we have observed during five years. Deformities and deviations are exceedingly rare in certain races of men, especially those who have the skin strongly coloured.' The development of the perfect form of certain of the lower animals, it is well known, depends on light.

50. The influence of the sun's rays in deepening the colour, or in giving a brown tint to the skin, seems to be more due to the light than to the heat of the sunbeams; for the parts of the skin covered by the clothes, though kept thus hotter than the parts exposed, do not undergo this change.

51. The pale visage and enfeebled vitality of those who live much in obscure apartments, in prisons, and in mines, are well known; and though probably the most violent symptoms that characterise the anæmia of miners, in which the skin assumes a yellowish waxy hue and the lips become bloodless, may be chiefly due to breathing a vitiated atmosphere, yet some influence is certainly attributable to want of light. The anæmia of persons long confined in dungeons has often been remarked, and was lately described as strikingly exemplified in the person of Caspar Hausser, the young man whose mysterious birth, confinement, and assassination have hitherto baffled conjecture.

52. But, recurring to the influence of the sun's rays on growth, 'we see,' says Dr. Edwards, 'that the action of light tends to *develope the different parts of the body in that just proportion* which characterises the type of the species. This type is well characterised only in the adult. The deviations from it are the more strongly marked, the nearer the animal is to the period of birth.'

53. If light thus developes, in certain races, the perfect type of the adult who has grown under its influence, we can hardly avoid the conclusion drawn by Dr. Edwards, 'that the want of sufficient light must constitute one of the external causes which produce those deviations in form in children affected with scrofula;' and the more so, that this disease has been observed to be most prevalent in poor children living in confined and dark streets. Following out the same principle, this distinguished physiologist infers that, in cases where those deformities do not appear incurable, exposure to the sun in the open air is one of the means tending to restore a good conformation.

54. If the light of day, then, freely admitted, into our apartments, is essential to the development of the human frame, physical and mental; and if the same blessed element lends its aid to art and nature in the cure of disease; it becomes a personal and a national duty to construct our dwelling-houses, our schools, our workhouses, our churches, our villages, and our cities upon such principles, and in such styles of architecture as will allow the life-giving element to have the fullest and freest ingress, and to chase from every crypt and cell and corner the elements of uncleanness and corruption which have a vested interest in darkness.

55. If it is important to obtain a proper illumination of our apartments when the sun is above the horizon, it is doubly important when he has left us altogether to a short-lived twilight, or consigned us to the tender mercies of the moon. In the one case it is chiefly in ill-constructed dwelling-houses and large towns and cities, where a dense population, crowded into a limited area, occupy streets and lanes in almost absolute darkness, that science is called upon for her aid; but in the other we demand from her the best system of artificial illumination, under which we must spend *one-third of our lives*, whether they are passed in the cottage or in the palace, in the open village or in the crowded city.

56. As regards the lighting of hospitals, window-blinds can always moderate the light of a well-lighted ward; but the gloom of a dark ward is irremediable. We *can* generate warmth, but we cannot generate daylight, or the purifying and curative effects of the sun's rays.

57. Dark barracks and barrack-rooms with northern aspects, it is well known, will furnish a larger amount of sickness than light and sunny rooms.

58. The danger of through ventilation is much exaggerated; for, excepting in a few well-known instances, the risks are hardly worth estimating, as compared to the benefits of the life-spring to the sick—fresh air. Patients in bed are not generally inclined to catch cold.

59. Catching cold while in bed follows the same rule as while we are up. If the atmosphere be foul, with the lungs and skin oppressed, and unable to relieve the skin by depuration, then a draught may bring a chill; but this is the fault of the foul air, not of the fresh.

60. As regards temperature, trifling variations are in general rather be ficial than otherwise; and a cooler atmosphere at night acts rather as a tonic.

61. It is much to be regretted that of the influence of light upon the human frame and upon the mind in health and disease, so little should be known to us; but let us hope that physicians and physiologists may be induced, by the importance of the subject, to avail themselves of their numerous opportunities in hospitals, prisons, and asylums, to study this great subject.

62. Our hospital architects in England do their best to shut out our rare and imperfect sunlight, and to keep pure air out of the wards as much as possible; while they provide for the sick being so arranged that the effluvium must pass over a succession of beds before it can escape.

Postscript.—Having presented to the reader an exposition of natural ventilation as arranged in the modern French hospitals, I will briefly state the plan and object of the late Mr. Mackinnell's invention; for it also purports to ventilate all kinds of buildings and all kinds of apartments through an entirely natural process, and by means, indeed, of a law of nature.

(*a*) This latter plan is recommended to us on the score of its simplicity and ready applicability to all kinds of areas, whether opening to the atmosphere vertically by the roof, or only horizontally by the external walls, and by the manner in which it equalises the waste and repair, without ever allowing the air to become deteriorated, or to be thrown into commotion by contending currents.

(*b*) The apparatus consists essentially of two tubes, the one placed within the other, with an annular space between them, and both opening freely into the external air. The internal tube, destined to carry off the vitiated air, is placed in the chamber to be ventilated, with its downward opening near the ceiling, towards which the air, from its superior lightness, naturally ascends.

(*c*) The annular space is intended to supply the waste, and accordingly the external air, which is denser and heavier than the vitiated air, naturally passes through it into the chamber.

(*d*) Were it left free, it would form an injurious descending current; but this is ingeniously obviated by a projecting flange, which, checking the entering air in its downward course, causes it to spread equally and horizontally over the whole area, without producing any of those sudden fluctuations of temperature, which, in other modes of ventilation, have been felt at once unpleasant and unsafe.

(*e*) Over the escape-tube there is placed a hood, so contrived as to prevent the admission of rain. This tube would be sufficient to allow all the foul air of a room to escape from it; and if doors and windows were kept open, there would be a constant supply of pure air.

(*f*) Draughts have to be avoided in any efficient scheme of ventilation, otherwise it would be an evil in place of the greatest good; but Mr. Mackinnel has a simple and effective method of supplying fresh and pure air, while he takes off that which has been consumed and corrupted.

(*g*) Attached to the outer tube, or that which envelopes, so to speak, the escape-tube, he has an arm or arms which pass at right angles, or by any other convenient direction, to the outer air; and while the inner tube is causing an upward and outward current, these arms lead the exterior and pure air into the concentric opening formed between the two tubes, where there is a constant downward current.

(*h*) The flange already spoken of spreads the air in a thin film across the ceiling of the apartment, whence it falls, in consequence of its greater gravity, in imperceptible columns, like rain, down through the body of air in the chamber.

(*i*) The whole aim of this apparatus is to give concentrated play and force to the natural action; and in this aim it seems completely to succeed, the inner tube drawing off like a chimney all the foul and heated air within, and the outer tube, with the air-ducts passing from it at right angles to the outer atmosphere, affording a passage to the pure air which flows to the vacuum thus created.

(*j*) Such is the simple, safe, and scientific means of the inventor, for the supply of an effective ventilation to every description of building. It is perfectly natural in its action, in which we perceive an absence of everything like forcing. On the contrary, fresh air is here introduced in a natural and imperceptible manner, and distributed over all areas, so as not to offend the most delicate lung or skin.

(*k*) While it has always been a most easy matter to produce strong currents of air, it has hitherto been found most difficult to devise means by which vitiated air should have an easy and certain escape, while the pure air should find an equally ready means of entrance; the egress and ingress being sufficient, yet so constant and imperceptible, as not to indicate any remarkable atmospheric action.

(*l*) This practical efficiency in ventilation appears to have been brought about by Mr. Mackinnel in an easy and cheap manner, capable now of being estimated by the rigorous test of the result.

(*m*) All descriptions of buildings, private and public, have been supplied with this apparatus, and always with the same results, as evidenced by numerous and unquestioned testimonies.

(*n*) The scheme aims at the attainment of its object by aid of a natural law; and with its good properties it has not hitherto been found to blend any evils, which is saying much for the inventor.

(*o*) In Merchant's Hall, Glasgow, when so full that nearly a thousand persons were assembled it it, two ventilators were found, in mid-winter, 'amply sufficient to keep the air sweet and wholesome;' the doors and windows being meanwhile kept closed.

(*p*) 'Such was their efficacy, that no perceptible change could be discovered between the air in the hall, when full of people, and when it was emptied.'

(*q*) So also, when applied to stables and a veterinary hospital, the air was fresh and free rrom all offensive and ammoniacal gases; while the horses were observed to recover from their respective diseases much more speedily and effectually than before.

(*r*) One peculiarity of Mr. Mackinnel's system remains to be noticed. It will not act, and there is no need for its action, in empty apartments having the temperature of the air inside of the same scale with the outer atmosphere. But when, in an occupied area, through the ascent of the warmer and lighter air consumed in expiration, the inside temperature becomes raised above that outside, then the processes of escape and admission begin; and they both proceed in exact and regular proportion—the one rushing out, and the other pouring and spreading inward, after the gradual and imperceptible manner already described, and as regulated by the demand for pure air of the area inhabited. To ventilate the corners of apartments, excepting by some such action as this, would appear next to impossible, through natural means.

Finally, the task to be performed is this: to ventilate all kinds of aparments, and enable the inmates to receive the amount of air requisite for health, thus counteracting all kinds of structural defects in private and public buildings. If Mr. Mackinnel can do this, and he appears to have done it, he will indeed have achieved a great victory, and confer a benefit on the public beyond estimation. If his system can do all this, it fulfils the most important purposes. It corrects the hitherto irremediable errors of structure in our barracks and hospitals—errors not to be corrected in any other way except by rebuilding; it renders barrack-rooms and wards of hospitals habitable which were before not habitable.

I hope that the foregoing remarks on the ventilation of hospitals may not be regarded by the reader as too long or too minute in their details. The subject is of the last importance, and the profession in a general way knows its importance. But there is a vast difference between the general perception of a fact and the actual realisation of its import; and this is my excuse for the length of the present section.

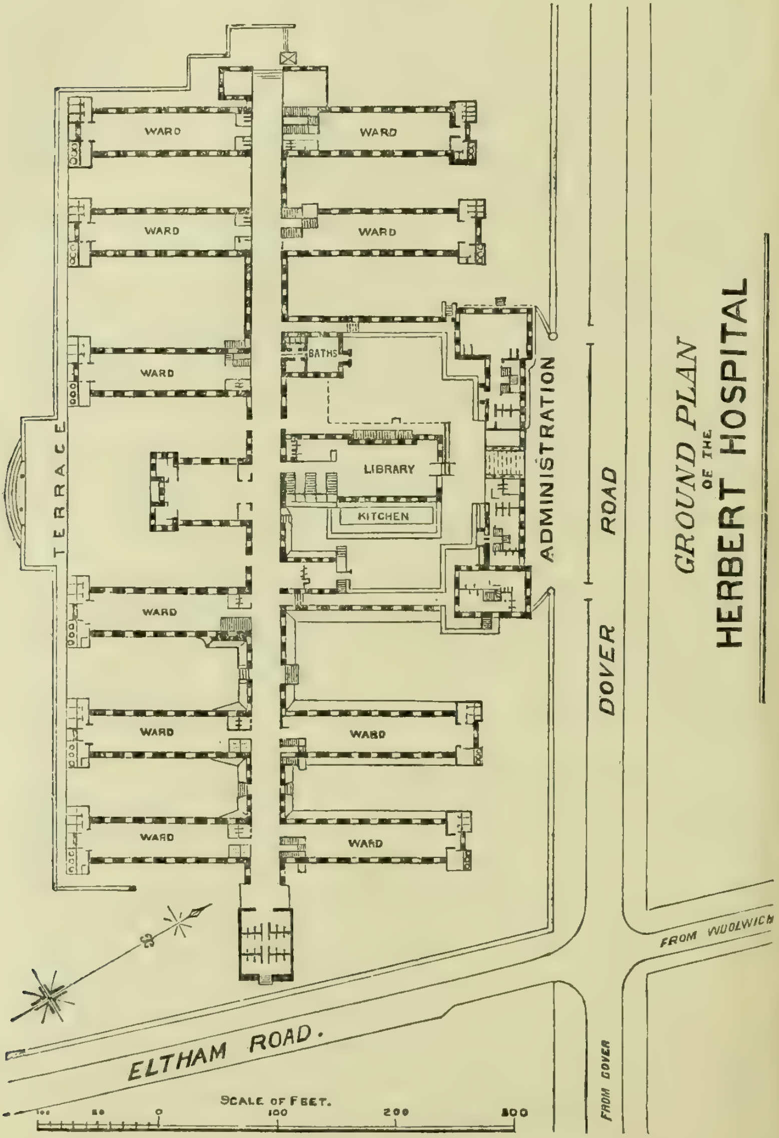
There are many important objects interesting to society which present themselves in contemplating the construction and the professional concerns of hospitals; and, as in commercial and other affairs of life, they will best be understood by men who have most directed their attention to the subject.

Since the above was written, an improvement upon all hospitals hitherto constructed has been made in our own country; and I cannot do better than present the brief statement of its advantages from the authority so often quoted in this essay.

'But,' says Miss Nightingale, 'all the advantages of the Lariboisière and Vincennes plans, without any of their disadvantages, and with greatly improved sanitary arrangements, will be realised in the new Herbert Hospital, now under construction at Woolwich. This, when completed, will be by far the finest hospital-architecture in the United Kingdom, or indeed in Europe. It consists of four double and three single pavilions, with the ends in the air. All the wards are raised on basements; those at the lower end of the ground are so lofty as to afford excellent accommodation for the museum, medical officer's room, board-rooms, and stores. There are only two floors of wards to each pavilion; and the distance between the pavilions is double the height of the pavilion, measured from the floor of the lowest ward. Every ward has a large end-window, commanding beautiful views; and the ablution and bath accommodation, together with water-closets, is placed in the free atmosphere at the end of the wards. Each large ward contains from twenty-eight to thirty-two beds, with windows along the opposite sides—one for every two beds; and each ward has a nurse's room and scullery.

'Unfortunately, the army-regulation number of cubic feet per bed has limited the height of the wards to fourteen feet. There is a convalescent day-room in the central pavilion. The kitchen is in a basement; also in the centre over it, there is a library; and over the library the chapel. All the administrative offices and quarters are in a separate block in front. The axis of the wards is a little to the east of north; and each side will receive the sun's rays during some part of the day. At one end of the hospital there are separate lunatic wards, with separate offices. At the other end is the operation-theatre, with a few small wards for special cases.

Fig. 429.



'The total accommodation is for 650 beds, in seven detached buildings, all connected together through the centre by a corridor one floor in height, with a basement corridor beneath, through which the whole service of the hospital, so far as regards the conveyance of diets, medicines, coals, and the removal of dust and foul linen, will be carried out. This is effected by a system of lifts and shoots; and the result will be, that the usual bustle observed in hospital passages will be altogether avoided.

'This hospital embodies the great administrative principle of an entire separation between what is immediately necessary for the sick and what is not so, and yet without interfering with the efficiency of the administration. Over the corridor is an open terrace, to which convalescents in the first-floor wards will have easy access in fine weather; and the covered corridor below will be available for exercise in wet weather.

'Each ward is 26½ feet wide and 14 feet high; and each bed has 93 to 97 superficial feet, and 1,200 to 1,400 cubic feet. The walls will have a polished light-coloured surface. It is intended to warm the wards by two open fireplaces along the centre of the wards, the flues being carried under the floor, and used for warming the air admitted to the wards. The floors are of iron beams, filled in with concrete, and covered with oak boarding. The whole will be fire-proof, and the sick in the lower wards will not suffer from noise in the wards overhead. Hot and cold water will be laid over the entire building; and the water-supply, which is taken from chalk, and hard, will be softened by the lime process before being transmitted to the hospital.'

Hygiene of Hospitals.

The hygiene of hospitals comprises the proper selection of localities, attention to suitable construction, ventilation, admission of light, supply of pure water, with means of flushing drains and sewers, proper diet and clothing, a just distribution of sick, personal hygiene, and personal attendance, &c.; in short, attention to all those well-known measures of prevention of disease, and of aids to cure, the suggestions of experience in hospital management, with which physicians and surgeons are now happily becoming better acquainted than was formerly the case.

2. Medicine has during long ages been in an unnatural condition of reversal or of transposition; and hence the art of healing has been more present to the minds of the professors of physic, and of the public consequently, than the science of hygiene. So highly, however, has hospital hygiene been appreciated in France for some time past, that hospital construction has there recently attained nearly to perfection. We are now following the good example, and may soon hope to equal, if not surpass, our neighbours.

3. Surgeons, too, while they have so frequently disputed about modes of performing surgical operations, have but seldom occupied themselves with an investigation of the causes of surgical fevers and other hospital diseases, producing annually, before and after surgical operations, so large a mortality in our charitable institutions. The supply of pure air, inside and outside the hospital, with a large supply of pure water for inside and outside purposes, will go far to prevent all such diseases.

4. The prevalence of surgical, puerperal, typhus, or typhoid fevers; erysipelas, pyæmia, sloughing, or profuse suppurations in wounds or ulcers, may everywhere be regarded as a sure proof of ill-construction, defective ventilation, and of insufficient personal hygiene in hospitals; while the rapid healing of wounds and sores, the absence of erysipelas and low fevers, may, on the contrary, be received as indices of excellence of plan, arrangement, and discipline.*

5. Every patient who is placed on the operating-table incurs a certain amount of risk of death; but when the operation is severe, and the hygienic conditions unfavourable, the risk incurred is as great, or even greater, than that

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* The bedding and bed-clothes should be carefully ventilated, as often as may be practicable, in the open air and sun's influence; otherwise, in apartments having heated air. This is a duty of the utmost importance in times of dangerous diseases, endemic or epidemic.

incurred in severe military enterprises, as battles and sieges. How careful and continual should therefore be our endeavours to secure the sanitary integrity of our hospitals, so as thus to aid by our best means the efforts of the physician and surgeon.

6. Miss Nightingale, referring to the organisation for sanitary purposes, government, and supply in hospitals, says: 'The first is really the most important. The sick at Scutari might have been loaded with medical comforts, attended by the first medical men of the age; and under sanitary conditions, such as there existed, they had not a chance.'

7. Referring again to the hygiene of hospitals, civil and military, the same authority adds: 'The distinction between personal and public hygiene must not be overlooked. It is acknowledged in civil life. The officer of health of towns,' who was first proposed by Mr. J. R. Martin, 'does not do the work of the physician or surgeon; and, on the other hand, you do not send for your physician or surgeon to drain your streets.'

8. 'Had an officer of health,' as proposed again by Mr. Martin, 'been attached to the quarter-master-general's department at the base of operations, who would have put to rights those buildings before we occupied them, how much life would have been spared!'

9. 'This officer should have full powers, through the quarter-master-general's department, to see, 1. to the draining of sites; 2. to the sewerage; 3. to the cleansing of outskirts; 4. to ventilation; 5. to water-supply; 6. to lime-washing and cleanliness of the buildings; 7. to the allotment of cubic space; 8. to the sanitary conduct of burials;' and so also in civil life.

10. 'There is here quite enough for one man to do. There is no more need for this administration of hygiene of buildings to clash with that of the personal hygiene of the patients, which must always be left to the medical officers, than in the precisely analogous case of civil life, where no man ever thinks of confounding the two.'

11. 'Before and after the works executed by the Sanitary Commissioners, begun in March 1855, the hospitals at Scutari bore a similar sanitary difference to that which the gaols of the last century, which were pest-houses, did to Colonel Jebb's prisons of 1857, the most healthy buildings in existence.'

12. 'The sanitary works were begun, and, after their completion, the mortality fell to less than one-sixth of what it was when the barrack and general hospitals were first occupied together in October 1854, and to one-nineteenth of what it was in February 1855. What other inference can be drawn from such statistics and conditions but this, that, had nothing been done, before four weeks were out, or as soon as the hot weather set in to give fresh strength to the seeds of epidemic disease buried among us, the hospital population of the Bosphorus would have been swept from the face of the earth, and there would have been no one left in those lazar-houses to tell the tale! Civil life is full of similar lessons.'

13. 'I am bound to say that the military hospitals I have seen in England—Portsmouth, Chatham, Brompton—are almost as much in want of certain sanitary works as Scutari.'

ADMINISTRATION.

Mr. Fonblanque observes, that 'it is not the *personnel* but the *morale*, upon which a sound administrative system hinges; a system based on the personal integrity of its agents.' The objects and ends to which everything in an hospital should tend, are—economy in expenditure, ease and expedition in labour, and exactness in the results. These great objects are attained by regulating the order of labour, by removing superfluous servants whose presence obstructs real labour, and by dispensing with useless labours which consume precious time, obstructing and postponing the results; by the establishment of a system, in fact, in which economy and humanity shall be equally respected. The success of the treatment of the sick in hospitals depends less on the remedial means than on the care, the vigilance, the regularity, and the order with which service is performed. Without that order, the sick run the greatest risks, even in the hands of the most able and the most practised.

2. By a perfect administration—by proportioning the number of trained servants to our wants—by regulating their various functions—by uniting economy with success, in fact—we may in some measure overcome imperfections in structural arrangements. But, on the other hand, when administration is ill-ordered, and the hospital building ill constructed, it is death to the inmates. Borne down by such overwhelming disadvantages—odds of our own creation—the highest talents and the best exertions of the physician and surgeon are set at nought.

3. Having made ample provision for the admission of light, and for securing freedom of ventilation, our hospital arrangements should, as stated, comprise the greatest economy in administration, consistent with the rapid healing of wounds, and the perfect recovery of the sick.

4. There should be facility of superintendence and nursing—the wards being of such a size, and so arranged, that the head-nurse may have all her sick under her eye at once : this is especially necessary for night service.

5. A nurse may adequately superintend a ward of from thirty to forty patients. But, if we are to be guided by the results of recent experience in hospital building, we should say that a ward of thirty-two sick, or thereabouts. is, upon the whole, the best for sanitary reasons

6. A convenient arrangement of lifts, and the laying of hot and cold water all over the building, economise attendance—certainly as much as one attendant to every thirty sick.

7. Provided always, that the medical staff be well chosen, it may be said of all hospitals, civil and military, whether we regard the credit of the institution, or the welfare of its inmates, that the less interference—the more the executives are trusted by the governing power—the better.

8. By the exhibition of a just confidence the governing body will secure in the medical staff that chastened zeal which has useful result for its object, and avoid that greatest curse of intermeddling—a cold performance of duty. Under a wise course of treatment we shall secure a cheerful system of subordination, and a progressive responsibility, without which no hospital, whether civil or military, can prosper. To unite men of like dispositions and pursuits, and make them coöperate for the public good, is to turn their talents to the greatest advantage.

9. In all establishments the improvement of the medical profession should be held systematically in view; and should any medical officer forfeit the confidence of the governing authority, he should at once be withdrawn. There ought never to be any medium between confidence and the want of it.

10. Miss Nightingale—always our highest authority—gives the following heads, in general terms, for the government and supply of a military general hospital:

11. *Government.*—One executive responsible head is what is wanted in a military general hospital, call him governor, commandant, surgeon-in-chief, or what you will; and let it be his sole command. Let him be military, medical, or civilian officer, as the possession of administrative talents point out a man for the work. The departments should not be many.

(*a*) A governor, solely responsible for everything but medical treatment.

(*b*) A principal medical officer and his staff, relieved of all administration, and strictly confined to his professional duties.

(*c*) A steward, who should fulfil the duties of purveyor, commissary, and barrack-master, and supply everything, subject to the governor.

(*d*) A treasurer, who should be banker and paymaster.

(*e*) A captain of hospital attendants, who should undertake the direction of the cooking, washing, care of hospital furniture, and government of orderlies.

12. All these officers must be appointed at home by the War Department. According to this plan, the governor would cumulate the functions of quartermaster-general and adjutant-general, and therefore the sanitary officer mentioned before would be attached to him instead of to the quartermaster-general.

13. The governor would be solely responsible for carrying out the works advised, and for engaging the labour requisite to do so. In civil life all the functions here particularised are vested in the superintendent or house governor, subject to the final control of the board or committee of management.

14. *Supply.*—The steward should furnish the hospital according to a fixed scale, previously agreed upon.

15. The mode of supply by requisitions is faulty both ways, both in pretending to supply that which is not in store, and in not supplying that which is; for the requisition remains, although the supply has never been given; and the supply is not often given, although it is in store.

16. With regard to food, let the steward make contracts, subject to the governor's approval, and with power to buy in the market at the contractor's expense, if the contractor fails.

17. A scheme of diets should be framed, according to the most approved authorities, in order to save the cumbrous machinery of extra diet-rolls.

18. Equivalents should be laid down, so as to afford the necessary choice, depending on the nature of the climate, the season of the year, the state of the market, the productions of the country, &c.

19. A registrar is an essentially necessary officer in a military general hospital. The absence of registration in the hospitals at Scutari left the accounts in general, and those of mortality in particular, of no reliance. 'They convey no trustworthy idea as to the sickness and mortality of the army in the East.'

20. The medical officers of our hospitals of the United Kingdom, whether physicians, surgeons, or apothecaries, are appointed by the votes of the governors, or by the nomination of council, as in the instance of the King's College and University Hospitals of London. The election to office by vote of the governors is, however, by far the more general mode.

21. *Hours of visiting.*—The hours for performing the medical and surgical services of hospitals would seem to depend on and be regulated by social habits; the visits being paid in France in the early morning, and in England during the afternoon.

22. *Number of beds to each Physician and Surgeon.*—M. de Watteville limits the number of patients to be placed in charge of each medical officer to forty; while in England the average appears to vary considerably. In our large London hospitals it is much above this number. The average of four such hospitals gives sixty-two beds to each officer having charge of in-patients; which number, however, is somewhat diminished in practice by the habit of allowing beds to obstetric physicians and assistant-surgeons. In the country the allowance is very much less. The average of eight country hospitals gave only twenty-five beds to each officer having charge of in-patients.*

Subdivision, distribution, and selection of the sick.—The proper subdivision and selection of the sick and wounded must everywhere constitute a primary consideration of hospital construction and general arrangement, for there is a certain ratio between the number of sick placed in a building, and in a ward, and the amount of mortality.

2. The number of patients admitted into an hospital does not by any means indicate the number of lives preserved, the degree of misery lessened, the sum of benefit to the community. The proportion actually cured and relieved, in a given brief period, is what truly expresses the happy consequences to society.

3. The system of hospitals is too often founded in error; the true systems being founded on the principle of relieving and dismissing in a short time; and thus the sum of patients relieved in a given period may be even greater from a less than from a larger number of inhabitants.

4. The extent to which subdivision should be carried must be determined

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* The numbers are taken from the Appendix to the Sixth Report of the Medical Officer of the Privy Council.

by the twofold consideration of uniting the greatest advantages as to health, with the greatest facilities as to administration, reference being had to economy.

5. Too great a subdivision of sick must necessarily incur an increase of cost in administration and nursing. On examining the experience of British and French hospitals, it is found that from a hundred to a hundred and twenty sick may safely and economically be treated under one roof, provided the ventilation and cubic space be sufficient, and the structure and communications of the building be so arranged as to facilitate the administration and nursing.

6. The wards should hold from twenty-five to thirty-two sick; each bed having from 1,500 to 2,000 cubic feet of air-space allotted to it.

7. The following table exhibits the proportions of a ward for thirty-two patients; the first column gives the proportions of such a ward in the Lariboisière Hospital; the second, the proportions adapted to a larger cubical space, such as is given in our best hospitals in this country:

Proportions of Ward.	feet.	in.	feet.	in.
Length of ward	111	6	128	0
Breadth	30	0	30	0
Height	17	0	17	6
Wall-spaces between end-walls and windows	5	0	6	4
Breadth of windows	4	8	4	8
Breadth of wall-space between windows	9	2	11	4
Height of windows	13	0	13	6
Cubic space per bed	1,760	0	2,100	0

8. The proportions of a ward for twenty patients might be 80 feet long by 25 feet wide and 16 feet high; this would give about 1,600 cubic feet to each bed.

9. One window at least should be allotted to every two beds, for purposes of light and air; there are hospitals with a window to each bed.

10. Much has of late been said about the benefits of small wards for from six to ten sick, about the greater comfort and privacy of such wards, and the greater facility for ventilation which they afford. It is simply an error to assume that small wards afford any such advantages. Privacy in an hospital does not extend beyond any two adjacent beds.

11. Each bed should have a space of eight feet on the average, with twelve feet between foot and foot; beds should be at least three feet apart; and where there are bad fever-cases, one bed should be empty, for the purpose of isolating each such patient. Impure air, whether emanating from the person or the excretions, diminishes as the square of the distance.

12. In our civil hospitals in England the amount of cubic space varies from 600 to 2,000 cubic feet per bed; in Paris, 1,700; and in London, 2,000, and even 2,500 cubic feet are now thought advisable.

13. In some military hospitals it was under 300; 700 to 800 appear to have been considered a somewhat extravagant allowance. The army regulation as to cubic space in hospitals was, up to a recent period, overcrowding.

14. In open sites and in the country a less cubic space is demanded than in towns. In detached pavilions, or in tents, especially if they be of but one story high, less cubic space is required than where numbers are massed together.

15. The very constitutions of sick and wounded persons render them more susceptible of morbid impressions than the healthy; the sick, therefore, ought always to enjoy a larger breathing-space than the healthy.

16. Cubic space above the bed is not sufficient for the sick, who should have

a sufficient surface-area also between the adjoining and the opposite beds. For the comfort and welfare of the sick each bed should have a surface-area of at least 8 feet wide by 12 feet long.

17. There will be a high rate of mortality amongst healthy men in large barracks, and a low rate in separate huts, even with a much less cubic space.

18. The largest of the Scutari hospitals, which contained at one time 2,500 sick and wounded under its roof, and where, at one time, not half even of regulation amount of cubic space was given, lost two out of five of the patients treated; while in the hospital tents of the Crimea, the sick being almost without shelter, without blankets, without proper food or medicines, the mortality was not above one-half what it was at Scutari.

19. But this was not the only danger of overcrowding; eighty cases of hospital gangrene were recorded during one month at Scutari, and very many more occurred which were not recorded; and out of forty-four secondary amputations of the lower extremities performed consecutively, thirty-six died. Fever also broke out in this miserable hospital, not by tens but by hundreds.

20. No stronger condemnation of any hospital or ward can be pronounced than the simple fact of any zymotic disease originating in it, or that such diseases have attacked other patients than those brought in with them.

21. With proper sanitary precautions, diseases reputed to be the most infectious may be treated in wards among other sick without any danger.

22. As to the proper distribution of the sick, four wards of ten patients each, taking the average of patients in London, cannot be efficiently overlooked by one head-nurse. Forty patients in one ward can be fully overlooked by one head-nurse.

23. Let us accept the principle that no hospital shall exceed two floors in height. By such an arrangement and construction the sick are spread over a wider area, the walls are not so high as to interfere with the sunlight and ventilation of the neighbouring pavilions, the accumulation of hospital miasm in the upper flats is avoided, access to the wards is easier for patients and attendants, and the whole administration is much facilitated.

24. 'It will cost more money to accommodate a given number of sick in a hospital of two than in one of four flats; but the question has been discussed and decided on the continent, notwithstanding, that the hospital of two flats is better than one of additional stories; and many hospitals of two stories have there been built.

25. 'But even admitting the argument of the expensiveness of land as being entirely valid, the conclusion is certainly not that hospitals three and four flats high should be built in towns; but that hospitals should be built in the country where land is less expensive.

26. 'It is little else than a breach of trust to build great lofty architectural structures, merely to flatter the bad taste of committees or governors; or to place the hospitals in a close unhealthy neighbourhood, to suit the convenience of medical attendants, when the object of the whole ought to be the recovery of the sick.

27. 'The number of sick which may be safely placed under one roof will, to a certain extent, be determined by the local position of the hospital, by the extent of cubic space allotted to the patients, and by the state of ventilation. In the most recent hospitals the numbers vary considerably.

28. 'Thus, in the Royal Marine Hospital, which is at present being erected at Woolwich, 84 sick are to be accommodated under one roof. In the proposed hospital at Aldershott there will be arrangements for about 100. In each of the hospital blocks at Beaujon, in Paris, there are arrangements for 60 sick. In the magnificent hospital Lariboisière, at Paris, the number is 102 per block. In the hospital St. Jean, at Brussels, it is about 88.

29. 'Too great a subdivision of sick must necessarily incur an increase of cost in administration and nursing. On examining the experience of all these hospitals, we are of opinion that from 100 to 120 sick may be safely and economically treated under one roof, provided the ventilation and cubic space be sufficient,

and the structure and communications of the building be so arranged as to facilitate the administration and nursing.'

30. Where labour is misapplied, it often happens that more time and care are given to passages, stairs, &c. than to the sick. To obviate this, extreme simplicity of construction and detail is essential.

31. Small casualty wards are much better placed apart, with their staff complete and separate, rather than attached—one small ward to each larger one.

32. Much superfluous argumentation has been thrown away upon the questions of the arrangement and distribution of sick in hospitals; discussions which might have been spared, had better hospitals existed in times past. Even now, indeed, much of what is set forth in this essay applies mainly to hospitals as they are; for it may be received as a truth having few exceptions, that if ventilation, cleanliness, and the general hygiene of an institution be duly attended to, we need trouble ourselves but little as to what description of cases shall be placed in adjoining beds in our wards, provided always that noisy or troublesome patients receive their special and proper places.

33. Eruptive diseases, eruptive fevers, erysipelatous diseases, ophthalmia, have been considered as demanding separate and more or less strict seclusion, on account of the safety of others; so much so indeed, that for the treatment of some of the diseases mentioned special hospitals have been founded.

34. Robert Jackson gives preference to the upper floors of hospitals which consist of two stories for the reception of cases suffering from acute diseases, as being less exposed to noise and bustle.

35. The benefits of classing the sick according to similarity of disease he considers as obvious, as regards economy of labour, facility for prescribing, and correct appreciation of effect.

36. An active discussion has lately taken place in the professional and also in the public journals, on the advantages and disadvantages of special hospitals for the separate treatment of various diseases. The question is an important one; and it is probable that it will receive a final settlement in financial considerations, and those connected with the public and the professional convenience.

37. When we contrast the incomes and the amount of actual relief, for instance, of the fourteen metropolitan general hospitals, with the incomes and the amount of relief in the thirty-six special hospitals of London, we arrive at once at a conclusion in favour of the former institutions, on the score of financial and charitable advantages.

38. What appears to be wanted is, to bring the two classes of institutions together under one roof; the general hospitals classifying special diseases in special wards, as already done in some of our great hospitals. By such arrangement the general hospitals will increase in power and usefulness, and the special hospitals will gradually give place to the cheaper and more beneficial charity.

Admission into Hospital.—The justice of the principle is unquestionable, that all indigent sick inhabitants, and all poor wayfarers who may fall sick on their travels, ought to be admitted into the nearest hospital; indeed, no hospital establishment, whether in our great cities or in the provinces, can be said to be complete until this desideratum shall be accomplished. All servants of the public, all seamen and soldiers of the state, should have free admission into the nearest civil hospital, it being understood that naval and military hospitals are too distant to be resorted to.

2. It has often been said that the greatest cause of inefficiency in all our general hospitals, whether in town or country, is the mode of admission of patients by governors' letters. This cause of inefficiency, according to Dr. Fenwick, who is here followed, exists in every hospital in England, with exception to the old endowed hospitals of London, the Royal Free, and the Metropolitan Free hospitals.

3. It is an evil which has towering proportions among the grievances of our calling; an evil which could only have arisen at an epoch when charity was mis-

understood, and when medical men were content to do with humility the bidding of rich people, even if the result should be dishonouring to the best traditions of medicine.

4. The system of admission by letters of governors entails such evils as the following:

(*a*) The admission of trivial cases.

(*b*) The admission of cases incurable, either from their stage or their nature.

(*c*) The crowding of the wards in undue proportion with patients suffering from chronic maladies.

(*d*) The detention of patients for fixed periods, with little regard either to the medical aspect of the cases, or the general necessities of the hospital; the impossibility of preventing over-crowding in times of epidemic pressure; the utmost perplexity to the direction when it becomes necessary suddenly to empty some, or the whole of the wards, for health-purposes; but above all, the necessary exclusion of cases for which hospitals were originally designed, and the existence of which alone justifies their maintenance.

5. Nothing is here said of the financial embarrassments which constantly hover over institutions that endeavour to do their duty to the public by admitting urgent cases and accidents, while they try to perform their contract with the subscribers by taking in persons sent under the authority of their recommendatory letters.

6. Nothing is said, again, of the wholesale admission of improper persons, without enquiry as to their being fit recipients of any form of charity. What is now desirable is, that these letters—or rather orders, as they are generally interpreted—shall no longer be permitted to throw an air of a sham over our British Hospital System. It is almost unnecessary to state that these ignoble letters do not exist in any part of the continent, have no place at St. Bartholomew's, Guy's or St. Thomas's, and are quite unknown in the Royal Infirmary of Edinburgh.

7. The only objection worthy of consideration to the overthrow of this privileged system is, the often-urged declaration, that subscriptions could not be obtained unless the privilege of recommending patients were appended to them.

8. This is believed to be a delusion. Is it probable that the sort of people who maintain the charities of England contribute their money for the purpose of obtaining a 'privilege'? Was this the motive which prompted the gifts to the Coventry weavers, to the poor Indian rice-growers, or to the Lancashire spinners? If it be made but generally understood by the public that the governing bodies and the medical officers of hospitals will always prove the best judges of the class of persons proper to be admitted to the benefits of each kind of charity, rights and privileges on the part of donors and subscribers will speedily be abandoned.

9. It is believed that many of the hospitals in London envy the subscription-list and the donations of the Royal Free Hospital, although it does not enjoy the *prestige* of a school, or of an hospital staff.

10. Some of the largest subscription-lists in England look insignificant by the side of that of the Edinburgh Royal Infirmary, though the city is not rich; yet on the fly-leaf of its reports we read this noble sentence—'that the selection of patients to be admitted shall be regulated solely by a regard to the relative urgency and severity of their ailments.'

11. In the city here named, there is a Children's Hospital, now in its seventh year of progress. The governors have no privilege whatever, not even that of electing medical officers. The annual subscription-list has already amounted to nearly 1,100*l.* There is, then, no reason for the averment that the public is not ready to support hospitals for their own sake, as necessary public charities. The time has come, as it appears to the author, for taking the verdict of our brethren on this important question.

The selection of patients.—Dr. Guy regards it as a fact that the great leading cause which determines the mortality of hospitals is the question here noticed. He says that 'the attendance of a numerous class of pupils craving for instruction leads naturally and necessarily to a selection of severe and dangerous cases, while the attachment of practitioners to their *alma mater* brings about with equal certainty a supply of cases for medical treatment and for surgical operation, among which cases an undue mortality may be expected to occur.

2. 'That this is the true explanation of the higher rates of mortality to be found in the tables published by the Statistical Society of London, is rendered in the highest degree probable by the fact that the four hospitals which present the highest rates of mortality are St. Bartholomew's and Guy's, King's College and University College. In the last of the series of published tables, the mortality of these four hospital-schools is shown to range from 110 to 115 in 1,000. The other hospital-schools are found to occupy an intermediate position between the four hospitals which have the honourable distinction of a higher rate of mortality and the hospitals which have no medical schools attached, and which enjoy the unenviable privilege of displaying a rate of mortality rising from 60 to 82 in 1,000.

3. 'Seeing that the rate of mortality in hospitals varies so little with locality, site, size, spaciousness, and so much with the sex of patients, and the medical and surgical character of their maladies, it is obvious that more may be done to raise or lower the rate of mortality of our hospitals by selection of patients than by all other causes put together, excepting always such a degree of overcrowding and neglect of obvious sanitary precautions as are no longer possible in the hospitals of London.

4. 'It must also be quite evident that if, to an unequal distribution of men and women, and a variable proportion of medical and surgical cases, we were to add the element of a selection by one hospital of the more serious class of cases, surgical and medical, and by another of cases of a less severe character, we should be able to produce at will almost any rate of mortality between the limits of 50 or 60 per 1,000 and 110 or 120 per 1,000.

5. 'Now, this sort of selection does go on almost unconsciously in the case of those hospitals which have attached to them medical schools, and in the greatest degree in those which have the largest schools, and through them the largest connection of old students.'

Such are the conclusions of Dr. Guy upon this most important question; and he promises to follow them up by a careful statistical record. We look forward with interest to the fulfilment of that promise; for the value of all opinion must end where demonstration begins.

THE DIETING OF THE SICK—HOSPITAL COOKING.

Regarding the practical common-sense views of Miss Nightingale to be of that kind of pure observation which so frequently precedes science, and which is always so profitable to undemonstrated science, I propose here to quote her rules on the subject of dieting the sick to some extent. I should desire, indeed, to quote her two articles entire, but space will not admit of such indulgence.

It is confidently stated that the diet in London generally, as compared to that of Paris, is more substantial, nourishing, and invigorating; and this advantage is said to attach to the Englishman both before and after he becomes a patient in the hospital.

2. 'In laying down rules of diet by the amounts of "solid nutriment" in different kinds of food, it is constantly lost sight of what the patient requires to repair his waste, what he can take and what he cannot.

3. 'You cannot diet a patient from a book; you cannot make up the human body as you would make up a prescription—so many parts "carboniferous," so many parts "nitrogenous," will constitute a perfect diet for a patient. The nurse's observation will here materially assist the doctor; the patient's "fancies" will materially assist the nurse.

4. 'Organic chemistry is useful, as all knowledge is, when we come face to face with nature; but it by no means follows that we should learn in the laboratory any one of the reparative processes going on in disease.

5. 'Chemistry has as yet afforded little insight into the dieting of sick. All that chemistry can tell us is the amount of "carboniferous" or "nitrogenous" elements discoverable in different dietetic articles. It has given us lists of dietetic substances, arranged in the order of their richness in one or other of these principles; but that is all.

6. 'In the great majority of cases, the stomach of the patient is guided by other principles of selection than merely the amount of carbon or nitrogen in the diet. No doubt, in this as in other things, Nature has very definite rules for her guidance; but these rules can only be ascertaned by the most careful observation at the bedside. She there teaches us that living chemistry, the chemistry of reparation, is something different from the chemistry of the laboratory.

7. 'An almost universal error amongst nurses is the bulk of the food, and especially of the drinks they offer to their patients. Suppose a patient ordered four ounces of brandy during the day; how is he to take this if you make it into four pints by diluting it? The same with tea and beef-tea, with arrowroot, milk, &c. You have not increased the nourishment, you have not increased the renovating power of these articles by increasing their bulk; you have very likely diminished both by giving the patient's digestion more to do; and most likely of all, the patient will leave half of what he has been ordered to take, because he cannot swallow the bulk with which you have been pleased to invest it.

8. 'It requires very nice observation and care (and meets with hardly any) to determine what will not be too thick or strong for the patient to take, while giving him no more than the bulk which he is able to swallow. . . . . . The diet which will keep the healthy man healthy will kill the sick one. The same beef, which is the most nutritive of all meat, and which nourishes the healthy man, is the least nourishing of all food for the sick man, whose half-dead stomach can *assimilate* no part of it, that is, make no food out of it.'

9. Respecting beef-tea and other articles of diet, much error has been heedlessly accepted for truth: 'One is the belief that beef-tea is the most nutritious of all articles.' It is of little dependence 'with the healthy and convalescent, where there is much nourishment required. . . . . . On a diet of beef-tea healthy men speedily lose their strength.'

10. But 'there is a certain reparative quality in it—we know not what;' and 'it may safely be given in any inflammatory disease.'

11. Dr. Christison observes, that 'everyone will be struck with the readiness with which certain classes of patients, as cases of gastric fever especially, while they refuse all other food, take readily to beef-tea or dilute meat-juice, using little or nothing else for weeks or even months; and yet a pint of beef-tea contains scarcely ¼ oz. of any thing but water.' The result, however,is so striking that he asks what is the mode of action. 'Not simply nutrient, ¼ oz. of the most nutritive material cannot nearly replace the daily wear and tear of the tissues in any circumstances. Possibly,' he says, 'it belongs to a new denomination of remedies.'

12. 'It has been observed that a small quantity of beef-tea, added to other articles of nutrition, augments their power out of all proportion to the additional amount of solid matter. The reason why jelly should be innutritious, and beef-tea nutritious, to the sick, is a secret yet undiscovered; but it clearly shows that careful observation of the sick is the only clue to the best dieting.

13. 'It is an ever-ready saw that an egg is equivalent to a pound of meat; whereas it is not at all so. Also, it is seldom noticed with how many patients, particularly with nervous and bilious temperaments, eggs disagree. All puddings made with eggs are distasteful to them in consequence. An egg whipped-up with wine is often the only form in which they can take this kind of nourishment.

14. 'Again, if a patient has attained to eating meat, it is supposed that to give him meat is the only thing necessary for his recovery; whereas scorbutic sores have been actually known to appear among sick persons living in the

midst of plenty in England, which could be traced to no other source than this, viz. that the nurse, depending on meat alone, had allowed the patient to be without vegetables for a considerable time, these latter being so badly cooked that he always left them untouched.

15. 'Arrowroot is another grand dependence of the nurse. As a vehicle for wine, and as a restorative quickly prepared, it is all very well. But it is nothing but starch and water. Flour is both more nutritive, and less liable to ferment, and is preferable wherever it can be used.

16. 'Flour, oats, groats, barley and their kind, are preferable in all their preparations to all the preparations of arrowroot, sago, tapioca, and their kind.

17. 'Milk, and all the preparations from milk, are a most important article of food for the sick. Cream, in many long chronic diseases, is quite irreplaceable by any other article whatever. It seems to act in the same manner as beef-tea, and to most it is much easier of digestion than milk. In fact it seldom disagrees.

18. 'Butter is the lightest kind of animal fat; and though it wants the sugar and some other elements which there are in milk, yet it is most valuable both in itself and in enabling the patient to eat more bread.

19. 'Cheese is not usually digestible by the sick, but is pure nourishment for repairing waste; and I have seen sick, and not a few either, whose craving for cheese showed how much it was needed by them.'

20. In a note on the instinctive cravings of the sick, Miss Nightingale makes an observation, the truth of which will be vouched for by all who, like her, have seen scorbutic dysentery: 'In diseases produced by bad food, such as scorbutic dysentery and diarrhœa, the patient's stomach often craves for and digests things, some of which certainly would be laid down in no dietary that ever was invented for sick, and especially not for such sick. These are, fruit, pickles, jams, gingerbread, fat of ham or bacon, suet, cheese, butter, milk. These cases I have seen, not by ones, nor by tens, but by hundreds. And the patient's stomach was right, and the book was wrong. The articles craved for, in these cases, might have been principally arranged under the two heads of fat and vegetable acids.

21. 'There is often a marked difference between men and women in this matter of sick feeding. Women's digestion is generally slower.'

22. Reverting to the article of milk, Miss Nightingale says: 'But, if fresh milk is so valuable a food for the sick, the least change or sourness in it makes it perhaps of all articles the most injurious; diarrhœa being a common result of fresh milk allowed to become at all sour. The nurse therefore ought to exercise her utmost care in this.

23. 'Buttermilk, a totally different thing, is very useful, especially in fevers.

24. 'The nutritive power of milk, and of the preparations from milk, is very much undervalued; there is nearly as much nourishment in half-a-pint of milk as there is in a quarter of a pound of meat. But this is not the whole question, or nearly the whole. The main question is, what the patient's stomach can assimilate or derive nourishment from; and of this the patient's stomach is the sole judge. Chemistry cannot tell this. The patient's stomach must be its own chemist.

25. 'I have known patients live for many months without touching bread, because they could not eat bakers' bread. These were mostly country patients, but not all. Home-bread or brown bread is a most important article of diet for many patients. The use of aperients may be entirely superseded by it. Oat-cake is another.'

26. Miss Nightingale justly observes that sound observation has scarcely yet been brought to bear on sick diet. 'To watch for the opinions which the patient's stomach gives, rather than to read "analyses of foods," is the business of all those who have to settle what the patient is to eat; perhaps the most important thing to be provided for him after the air he is to breathe.'

27. The circumstances which call for variations as to quality and quantity of

food in hospitals, are: Nature of the disease, whether acute or chronic, sthenic or asthenic; age; sex; previous habits of life; employments; season; conformation of body.

(*a*) *Nature of the disease.*—There is perhaps no diseased state found in hospitals for the cure of disease in which so much food should be given as in health. In acute disease, the activity of all the functions must be lessened, and therefore less food of all kinds given, especially of the nitrogenous kind, since on that quality mainly depends the activity of function. In chronic disease there is usually a reduced state of the powers of transformation, and hence starchy food should not be given in excess; while a full admixture of nitrogenous food is called for. Moreover, the heart's action is often enfeebled in such states; and then nutritive articles of diet, with ale or wine, are called for.

(*b*) *Age.*—Under the age of twenty-two, some excess of food must be allowed to maintain growth. In old age the quantity should be less than in middle life; and then the quality should be such as to contain more nitrogenous food, or that which promotes the transformation of starch and fat. Arrowroot taken alone is then wasted, and probably the same may be said of fat.

(*c*) *Sex.*—The difference in the amount of nutriment required by the two sexes is less than is found in the dietaries of gaols. The chief ground for the difference is, the difference in weight and size of the body.

(*d*) *Previous habits and employments.*—These considerations must constitute a reason for variation in diet; but, from evident causes, the requirements can only be met by having two or more classes of dietaries, one of which shall suffice for those whose occupations have been more laborious, and another for such as have been of sedentary habit; more nutriment being, as matter of course, required for the former class.

(*e*) *Season.*—The quantity of food supplied in the winter months should be one-sixth greater than in June, July, August, and September, and it should be rich both in nitrogen and carbon. In the summer months the quantity of starch and fat should be much lessened, and in a greater degree than the nitrogenous, since then the powerful indirect transforming action of cold is absent.

(*f*) *Conformation of body.*—The chief circumstance here to be noticed is, that persons of unusual height and girth demand an unusual supply of food.

28. Dr. Edward Smith offers the following suggestions for a scheme of dieting fitted for the Liverpool Infirmary and the general hospitals of the country:

'There should be but three dietaries.

(*a*) 'The normal one, which would be proper for ordinary cases, where the supply should as nearly as possible balance the waste.

(*b*) 'The sick dietary, suited to acute cases, in which the supply is insufficient to balance the waste.

(*c*) 'The convalescent dietary, in which the supply is greater than the waste. Such terms as "low," "full," &c., are inadmissible, since they influence the minds of the patients, and probably mere numerical distinctions would be best.

29. 'There should not be such variation in the food supplied from day to day as would materially vary the amount of nutriment supplied; and when alterations are provided, they should be nearly equal in nutritive value; as, for example, eggs for milk, or peas for cereals. Such alteration should be exceptional, and be applied to the special case of the patient.

30. 'Milk should form a large part of every hospital dietary. Thus, in B, three-fourths of a pint at breakfast and supper; and in C, a pint at each of those meals.

31. 'I doubt much if more than 4 oz. of cooked meat without bone ought to be given to men, or more than 3 oz. to women in any class; and I should recommend these quantities in B and C. I am persuaded that too much meat

is given in many hospital and prison dietaries, considering the healthfulness, vigour, and duration of life of the agricultural population living almost without it; and also the evils met with in towns' populations, amongst the well-fed, who yet seldom eat more than the above allowance. I have seen great evils in hospital practice from an unlimited supply of meat, even in such cases as phthisis.

SCHEME.

	A (sick).	B (normal).	C (convalescent).	NOTES.
BREAKFAST. 8½ A.M.	⅓-pint milk, 3 oz. bread (or oatmeal).	¾-pint new milk 6 oz. bread 2 oz. oatmeal.	1 pint new milk, 8 oz. bread, 3 oz. oatmeal.	N.B. The milk should be new or old, as fat is improper, or otherwise.
		When cocoa or coffee with sugar is given, omit the oatmeal, and give ½ pint milk.		
DINNER, 1½ P.M.	½-pint milk, made into pudding, with rice, sago, &c.; or ½-pint beef-tea, 4 oz. bread.	Meat, 4 oz. men 3 oz. women Bread . 6 oz. Potato . 8 oz. Cheese . ½ oz.	——— 4 oz. ——— 3 oz. ——— 8 oz. ——— 8 oz. ——— 1 oz.	The *beef-tea* should be made hot or cold, as the albumen is improper, or otherwise.
		¾ pint of broth, with boiled meat.		In A and C the broth should contain herbs.
SUPPER, 6½ to 7; bed at 8.	All the same as breakfast, with addition of cereal.			In all salt supplied *ad. lib.* Malt liquors as exceptions.

32. 'The meat should be of the best quality, from good joints, be served hot, be roasted or boiled, and be varied in kind; and when boiled, the liquor should be served with it.

33. 'Considering that potato is two-and-a-half times dearer than an equal amount of nutriment in bread, I would limit the supply of it to half-a-pound, cooked.

34. 'Seeing that in a day of fasting the carbon exhaled is equal to that contained in twenty ounces of bread, the daily supply of bread to B should not be less than eighteen ounces, and to C not less than twenty-four ounces.

35. 'Cheese, in small quantity, should be supplied after dinner, both because it promotes the transformation of food, and adds largely to the nitrogen. Half-an-ounce to B, and one ounce to C. When bread and cheese is preferred to bread and milk for supper, it would be easy to determine the suitable equivalent, since cheese also contains fat.

36. 'I cannot think that tea is proper in B and C, except when the assimilative function is much deficient, and then the bulk of fluid should be so small as to admit of the addition of half-a-pint of milk. I would make it an exceptional article of dietary.

37. 'Coffee might with less impropriety be given with half-a-pint of milk for breakfast; but it is clear that both tea and coffee tend to increase waste.

38. 'The various cereals with milk are the most suitable for breakfast and supper.

39. 'In my opinion, a sick dietary should differ from the foregoing only

in the lesser quantity of the above-mentioned articles, and care should be taken not to rely upon such articles as tea, which increases waste, or beef-tea made hot, which can only very partially sustain the animal functions. I think a too great deficiency of nutriment is often found in the "low diet."

40. 'In the above scheme there would be fat in the milk ($\frac{3}{4}$ oz. in 1 pint) and in the well-fed flesh ($\frac{1}{8}$), and this, with or without butter, would be ample, in addition to the starch supplied in the cereals and the potato. I have also been influenced in my opinions by my experiments published in the *Philosophical Transactions* for 1859, and in the *Dublin Quarterly Journal* for February 1860.'

41. *Cooking.*—'Many a patient can eat,' says Miss Nightingale, 'if you can only tempt his appetite; the fault lies in your not having got him the thing that he fancies.

42. 'But another patient does not care between grapes and turnips—everything is equally distateful to him. He would try to eat anything which would do him good; but everything "makes him worse." The fault here generally lies in the cooking.

43. 'It is not his "appetite which requires tempting"—it is his digestion which requires sparing. A good sick cook will save the digestion half its work.

44. 'There may be four causes, any one of which will produce the same result, viz. the patient slowly starving to death from want of nutrition:

i. Defect of cooking.
ii. Defect in choice of diet.
iii. Defect in choice of hours for taking diet.
iv. Defect of appetite in the patient.

Yet all these are generally comprehended in one sweeping assertion, that the patient has "no appetite."

45. 'Surely many lives might be saved by drawing a closer distinction; for the remedies are as diverse as the causes. The remedy for the first is to cook better; for the second, to choose other articles of diet; for the third, to watch for the hours when the patient is in want of food; for the fourth, to show him what he likes, and sometimes unexpectedly. But no one of those remedies will do for any other of the defects not corresponding with it.

46. 'I cannot too often repeat, that patients are generally either too languid to observe these things, or too shy to speak about them: nor is it well that they should be made to observe them; it fixes their attention upon themselves.

47. 'Again I say what *is* the nurse or friend for, except to take note of these things, instead of the patient doing so?

48. 'It is commonly supposed that the nurse is there to spare the patient from making physical exertion for himself; I would rather say, she ought to be there to spare him from taking thought for himself. I am quite sure that if the patient were spared all thought for himself, and *not* spared all physical exertion, he would be infinitely the gainer.

49. 'The reverse is generally the case in the private house. In the hospital, it is the relief from all anxiety, afforded by the rules of a well-regulated institution, which has often such a beneficial effect upon the patient.'

Nursing and Nurses.

In Military Hospitals.—In all European states there are more women than men above twenty years of age; and we may assume that such is the law of nature, and that it is designed to answer beneficent ends in human society.

It should seem obvious enough that the virtues which in all ages and all countries have ruled the domestic circle; that 'she who looketh well to the household, and eateth not the bread of idleness;' that she whose 'tongue is the law of kindness,' should have a natural and a large share in the tending of the sick and maimed. To the natural care of the sick and wounded, we must add the natural care of the infant and the aged, along with the household cares and the rearing and training of children.

Requirements of so extended and important a character, capable of such infinite development, cannot be limited to the household affairs of common life. They must be brought systematically in aid of the sick in hospital, for purposes of nursing and of general administration.

2. One of these ends, whether in private or public relation, would appear to be the care of the sick; an occupation for which woman, whether taken from the instinctive tuitions of the sanctuary of home, or from the trained service of the hospital, possesses unequalled aptitudes and capabilities. Everywhere and at all times the number of nurses to be employed in a hospital must be regulated by the nature of the prevailing diseases, whether epidemic, acute, or chronic.

3. So far back as 1791, we find it stated by the governors of the London Hospital, that 'women are better judges than men upon many occasions; particularly in what relates to women's wards, the laundry, the kitchen, to beds, linen, &c.'

4. Donald Monro, in his observations on 'Movable Hospitals on Expedition Service,' speaks of the 'matron or head-nurse,' and of the 'common nurses,' as ordinary matter-of-course parts of the hospital service of his time (1760-1780), and he proposes excellent regulations for their conduct.

5. In the Artillery Hospital, Woolwich, in 1801, Dr. Rollo states that a matron and nurse formed part of the permanent establishment. 'There was a nurse to every three wards, being a charge of fifteen to sixteen patients, whose duty it was to attend upon the men, make their beds, supply them with drinks, keep them clean, and take the charge of preserving the furniture and utensils, and of washing and sweeping the rooms. The duty of washing and sweeping the galleries and passages is done by the nurses alternately in a period of a week at a time. They also take in rotation the duties of night-nurses, when there are patients requiring such attendance.'

6. In the artillery hospitals in the West Indies, a nurse was allowed for every twelve sick. Dr. Rollo adds, that 'the nurses and servants ought to be entirely under direction of the surgeon, and to be answerable to him alone for their conduct, and for holding their appointments.'

7. As regards the principle of female service, our main object should be, to improve hospitals by improving hospital-service; and to assure so essential a benefit to the sick, we must improve the class of nurses and head-nurses.

8. Miss Nightingale thinks that the woman is superior in skill to the man in all matters of sanitary domestic economy, and more particularly in cleanliness and tidiness. Sanitary civil reformers will always tell us that they look to the women to carry out practically their hygienic reforms. She has a superior aptitude in *nursing* the well quite as much as in nursing the sick. At the same time, Miss Nightingale is bound to say that nothing can be more perfect, at least to outward appearance, than the cleanliness of a ship. But the sailor is a race *à part*.

9. It is the peculiar skill and industry of the English labourer's wife to which all this is referable in the one case, and to the incompetency of men on the other to conduct the domestic economy of a home or a hospital. Miss Nightingale thinks the Anglo-Saxon would be very sorry to turn women out of his own house, or out of civil hospitals, hotels, institutions of all kinds, and substitute men-housekeepers and men-matrons. The contrast between even naval hospitals, where there are female nurses, and military hospitals, where there are none, is most striking in point of order and cleanliness.

10. There is a great difference in Miss Nightingale's experience, generally speaking, among the women of Great Britain and Ireland in this respect. She would put the Anglo-Saxon race in the southern and north-western counties first in point of domestic management; far below these come the Danish race in the eastern counties, and the mixed race in the manufacturing counties; and last, the Irish and Highland Celt.

11. Our authority proposes to introduce so great and necessary an improvement into our hospital management, 'not by founding a religious order, as on the continent of Europe, but by training, systematising, and morally improving, as far as may be permitted, that section of the large class of women supporting themselves by labour, who take to hospital nursing for a livelihood; by inducing, in the long-run, some such women to contemplate usefulness, and the service of God in the relief of man, as well as maintenance; and by incorporating with both those classes a certain proportion of gentlewomen who may think fit to adopt this occupation without pay, but under the same rules, and on the same strict footing of duty performed under definite superiors. These two latter elements, if efficient (if not, they would be mischievous rather than useless), I consider would elevate and leaven the mass.

12. 'The care of the sick is the main object of hospitals. The care of their souls is the great province of the clergy of hospitals. The care of their bodies is the duty of the nurses. Possibly this duty might be better fulfilled by religious nurses than by sisters of any order; because the careful, skilful, and frequent performance of certain coarse, servile, personal offices is of momentous consequence in many forms of severe illness and severe injury; and prudery, a thing which appears incidental, though not necessarily so, to female orders, is adverse to or incompatible with this.

13. 'Grave and peculiar difficulties attend the incorporation of members of orders, especially of Roman Catholic orders, into the work. And both with reference to the Queen's hospitals, and still more to civil hospitals, I humbly submit that much thought, and some consultation with a few impartial and judicious men, should precede the experiment of their introduction. This appears to me one of the most important questions for decision. Should it be decided in favour of their introduction, I trust it may be resolved to do so only tentatively and experimentally.

14. 'Their introduction is certain to effect far more harm in some ways than it can ever effect good in others.' Their incorporation, especially as regards the Roman Catholic Sisters, will be a constant source of confusion, of weakness, of disunion, and of mischief.

15. Nurses cannot be advantageously introduced into our regimental hospitals; but into military general hospitals female nursing might be introduced both at home and in the field, if only women of efficiency, responsibility, and of as good character as head-nurses in civil hospitals, be appointed.

16. One nurse may be allotted to not less than twenty-five bad cases; the orderlies doing, under the head female nurse, the duty done in civil hospitals by assistant nurses.

17. But the head female nurse must be in charge of all that pertains to the bedside of the patient—of his cleanliness, that of his bed and utensils, of the administration of medicine, of food, of the minor dressings not performed by the surgeon; in short, all that concerns the personal obedience of the patient to the orders of the surgeon.

18. The head female nurse must accompany the surgeon in his visits, and receive his orders. She must also be in charge of the ventilation and warming of the ward. She must report any disobedience of orderlies, as far as regards the patient's personal treatment.

19. There need be no clashing with ward-master or hospital-sergeant; on the contrary, it would be the duty of these to enforce the nurse's authority. They will have enough to do besides, with returns and accounts, and with enforcing discipline as to hours, meals, clothing, &c. among the orderlies out of ward.

20. The female nurses should, of course, be under a female head, whose duties must be carefully arranged, so as to be in accordance with the code of hospital regulations.

21. By hospital discipline Miss Nightingale means the 'enforcing hospital treatment; and hospital treatment consists in the administration of medicine, of diet, the application of the minor dressings, the cleanliness of the ward, that of the patient, his bedding, and his utensils; his personal obedience to the

surgeon's orders as to keeping his ward, his bed, or his position, &c. &c. To enforce in all these matters obedience to the surgeon's orders, is to enforce hospital discipline.

22. 'Another branch of discipline consists, no doubt, in the man's respectful demeanour to his officers, in the accuracy of the diet-rolls, returns, accounts, &c. &c. This is not here spoken of, because it is not strictly hospital work. In hospital work, the meaning of the words to be "in charge" is, we presume, to receive the medical officer's orders, to see them obeyed, and to take measures so that they cannot be disobeyed without its being known and remedied.'

23. Now, in military hospitals there is no one *thus* 'in charge.'

24. The ward-master or hospital-sergeant has duties so multifarious that three men could not perform them with any satisfaction; and the nursing work is generally sacrificed to the writing work, unless the ward-master be, as sometimes, though rarely, happens, a very good nurse.

25. 'The orderlies do not bring "skilled labour" to the work, and the medical-staff corps bring far less. There is no training; it is a truism, that less work is done less well in the same time by unskilled than by skilled labour.

26. 'The cleaning and airing of the wards in the morning would make a housemaid laugh; at Scutari each orderly worked at it in his own way, and then the patients undid it all, and it had all to be done over again.

27. 'Except when medicines were given by the medical officers themselves, or by the women, they were taken by the patient or not, at his own discretion.

28. 'The meals were at first irregular, and throughout the patients scrambled for them. It occurred frequently that the bad cases, when unable to feed themselves, were not fed at all, except by the women; that a great mess of cold arrowroot and wine stood by the bedside the whole day, till it was thrown away; that the poultices were put on cold, or left on till they were hard, and then not washed off; that the bed-sores were unattended to till they had become so bad that the medical officer's attention was called to them; that the patients were left dirty, unless they asked to be washed; that utensils were never emptied more than once a-day; that the keeping certain very bad cases constantly dry and clean was almost wholly unattended to; that the patients ordered to remain in bed were as often out of bed, or even out of the ward, or smoking in the privies, when these were cleansed and ventilated. The position of surgical cases in bed was generally not attended to.

29. 'Many orderly medical officers were so zealous in their duties that they would drudge through all these details, and see them carried out themselves; but this is not discipline, nor can it be, unless the medical officer were in his ward through the whole twenty-four hours.

30. 'The medical staff-corps are, for the most part, nothing but sweeps and ration-carriers. There are some first-rate subjects among them; but the endowments of most of them were first-rate ignorance of the very details of nursing.

31. 'If all the nurses were turned out of civil hospitals, and men engaged promiscuously, without character, to do the work, we should see the same results.

32. 'The medical inspectors, as far as I saw them, with some very brilliant exceptions, regarded only hospital order and mere conduct, with little reference to the state of the patients. One patient suffering from frost-bite, who subsequently died, had not been moved for a week. Being unable to leave his bed, and having been neglected, he was found in a state indescribably horrible.'

33. Every ward, or set of wards, should be under a head-nurse. Discipline is always defective under other arrangement, whether in a military or a civil hospital.

34. Of acute cases, one nurse may well take charge of forty patients; while of convalescents or persons under chronic ailments, a hundred would be sufficiently served by one nurse.

35. A single attendant can easily perform the duty of night-watching for

many bad cases if the beds are so placed as to be seen from a single point. The head-nurse's room should have a window looking into her ward.

36. It is highly important that patients, who must necessarily be in various stages of sickness or convalescence, should feel that they are continually under the eye of the head-nurse.

37. It is, of course, most economical to have one ward for each head-nurse. The ward, therefore, should be large enough to occupy her whole attention; but not so large as to render its ventilation difficult.

38. Small wards cannot be overlooked with sufficient strictness, unless indeed a head-nurse is to be set apart for each—an arrangement which would enormously increase the expenses of nursing, without benefiting the patients.

Nurses in civil hospitals.—'The isolation of each head-nurse and her nurses appears to me very important. The head-nurse should be within reach and view of her ward both day and night. Associating nurses in large dormitories tends to corrupt the good, and make the bad worse. The ward should have but one entrance; and the head-nurse's room should be close to it, so that neither nurse nor patient can leave, nor anyone enter the ward without her knowledge.

2. 'The day-nurses should have eight hours' sleep, and if it be possible, four hours daily for exercise, private occupation, or recreation. They may have one room.

3. 'The night-nurses should be on duty twelve hours, with instant dismissal if found asleep; eight hours should be allowed for sleep, and four hours for daily exercise, private occupation, or recreation. If they have no time to themselves for their mending, making, &c., they do it at night, sometimes innocently, sometimes to the injury of the patients.

4. 'I would not, however, prohibit occupation at night; and doing something is far better and more awakening than doing nothing. This is one of the matters the head-nurse should constantly look to. I do not fancy, but at present am not positive about, cleansing or scrubbing at night. The night-nurse should have a reversible lamp, or something that, without disturbing the patient, gives her light, brighter than the dim fire or gas-light properly maintained in the wards at night. She should have a room to herself.

5. 'At present I incline to something of the following scale. Two wards, single are best, but it might be one double ward, with forty beds, served by one head-nurse and three nurses.

6. 'The head-nurse to superintend all things, and to do the dressings not done by the surgeons and dressers, assisted mainly by one nurse, whom she thus instructs in nursing.

7. 'Another nurse to do the scrubbing and mainly the cleaning; and when these are over, to mind the ward during the remaining hours in turn, or in conjunction with the first nurse.

8. 'The third to be the night-nurse. In the morning, before dressing begins, and before the night-nurse goes off duty, all three nurses to clean the ward, make the beds, wash the helpless patients, &c.

9. 'Hours of administration of medicine to be fixed, and the medicine always, except at night, to be given by the head-nurse.

10. 'Hours of morning and evening poulticing and dressing to be fixed.

11. 'Hours of exercise of head-nurse and nurses to be fixed and arranged with reference to duties. A fixed occasional holiday given in turn to the nurses is good; and an annual longer holiday for them and for the head-nurses is good; a fortnight being a good limit.

12. 'The holidays should be distributed in rotation during a fixed time of year, and comprehended in two or three months, or four at the outside; and no woman declining her holiday at the proper time should be allowed it at any other.

13. 'The holidays cause inconvenience no doubt, but do, on the whole, far more good than harm.

14. 'No head-nurse or nurse should be out of the hospital before or after the limit of her daily exercise-time, two hours, without written permission of the

matron. The matron should put the cause and amount of the extension in writing, and report the same to the treasurer or chief officer at the next general meeting of the officers of the hospital. She will find this a great protection against petitions; and there is no doubt that the fewer extraordinary absences the better.

15. 'Were it possible to have a small garden; in this, at strictly separated hours, the men-patients, the women-patients, the head-nurses and nurses, the men-servants if they chose, which is perhaps not likely, could walk or sit down. In college, much effect and much refreshment is produced by a green sward, a few trees, some shrubs, a fountain, and some seats.

16. 'This arrangement would little interfere with its enjoyment by the dignitaries and their children, who require it quite as much, and it would be found in its results practically, and not poetically, useful.

17. 'Hospitals are, and perhaps must be, in or near crowded thoroughfares. Streets are miserable places to walk in during great part of the year. Nurses want and unconsciously crave for fresh air, and often half-an-hour is better than more given them close to their work; and away from the streets it would be a great preservation.

18. 'I should, however, be very cautious as to introducing music or anything of that sort. Hospitals are not tea-gardens, nor homes, nor meant to be either. Great quiet, and some severity of discipline, are necessary, and ought to be exacted.

19. 'I think the head-nurses should wear a regulation dress, and the nurses another: if we adopt the honest word "livery," in use in the hospitals, it will perhaps do no harm. Caps, dresses, and aprons should be prescribed; whether or not out-of-doors dress should be prescribed, is to be considered apart.

20. 'Head-nurses and nurses might wear the same dress, and some difference in the cap would be quite distinction enough. Each should have three dresses, and better, I think, avoid washing-stuffs. They require endless change to look decent.

21. 'All nurses should rank and be paid alike, with progressive increase of wages after each ten years' good service, or a slow annual rise, which is better.

22. 'Nurses should be of unblemished character; of strong active habits; of not less than thirty, nor of more than sixty years of age.

23. 'I incline towards giving the head-nurses 50*l.* a-year, one or two rooms (one room with an alcove and curtain would be best), fuel, and light. As to the nurses' lodging: the night-nurse should have a room to herself, the others may lodge together; entire board, fuel, light, and good wages to be given.

24. 'The nurses' room should be supplied with plain comfortable furniture. In large hospitals, the head-nurse furnishes her own room or rooms, which doubtless promotes her comfort and her care of the furniture—both desirable things; yet the tendency of many to accumulate decorations, which take time to clean, &c., is a drawback.

25. 'I should be inclined, as an experiment, to try the furnishing plan, or at least to have some scale as to furniture allowed. A bed, arm-chair, and sofa; a chest of drawers, wash-hand table or shelf; bookcase or shelves; a little table and a large one, a couple of chairs, a footstool, and a cupboard with broad shelves, are the utmost that can be required.

26. 'All provisions, &c. &c. should be as much as possible brought into the wards, or to the ward-doors, by lifts. Nothing should be fetched by the nurses. This would save much time, would enable the nurses to do more work, and yet have more leisure; and above all, would obviate the great demoralisation consequent on the nurses, patients, and men-servants congregating in numbers several times daily.

27. 'The patients should be made as useful as possible, consistently with their capacities, inside the ward; but should be permitted to fetch nothing into it.

28. 'A difficult and important point to settle is the amount of liberty allowed as to receiving visits. It is desirable on all accounts to make head-

nurses and nurses feel comfortable, and, as it were, at home; it is also better they should not be unnecessarily out; also London distances are great, and even omnibus-fare is a consideration; also it is important to remember that these women are apt to feel and say, "We are not in a nunnery," nor should they be.

29. 'Such are the nuisance of ordinary visitors, and the greater nuisance of extraordinary visitors, that I think, if it were possible to make the rule that no visitors are allowed, it would be a great gain.

30. 'But at all events, nurses and head-nurses should only be permitted to receive visitors on certain days and hours of the week; and those hours and days should be strictly kept to. In military hospitals a still more rigid rule will be necessary.

31. 'No discharged patients, however well conducted previously, should be allowed to visit the wards.

32. 'Have no occasional wards, or wards for accidental and peculiar patients.'

33. To the question of the Royal Commissioners, appointed to enquire into the regulations affecting the sanitary condition of the army—'Are there not matrons in all the best civil hospitals?' Miss Nightingale replied, 'In all that I am acquainted with.'

Respective Duties and relative Position of Nurses and Orderlies.—1. 'The administration of diets and of medicine, the making of poultices, the application of leeches, blisters, and minor dressings, the management of the ventilation and warming of wards, should always be in the charge of the head-nurse.

2. 'Under her, the cleanliness of the ward, bed, bedding, and utensils of the patients, as well as their personal cleanliness, the fetching of diets, the warming and ventilation of the wards, are to be attended to by the orderlies, but always under the nurse's surveillance; and she is to have the power of reporting disobedience on their part.

3. 'The best class of men to be recruited for the medical staff corps are discharged soldiers, or civilians of good character; they should always be men who can read and write.

4. 'If they are to nurse, they should be instructed in the duties of nursing, as also in those of cleaning, &c., by head female nurses, who understand these things. To the superior ranks, a few simple anatomical lectures might be given by the medical officers.

5. 'Dispensers must, of course, be suitably educated, if they are to dispense.

6. 'The proportion of orderlies should not be less than one to every seven sick, where there is no head female nurse. I am not speaking of convalescents.

7. 'Where there is a female head-nurse, but no lifts, or supply of hot and cold water all over the buildings, still one orderly to every seven patients will not be too much. On an average, these two appliances make the difference of one orderly's duty to a ward of thirty sick.

8. 'Again, a ward of thirty sick, with these appliances, will be better served by three orderlies and half a nurse (for one head-nurse could see after two such wards), than a ward without the appliances could be by four orderlies.

9. 'The proportion of severe cases in military hospitals being generally much smaller than in civil ones, one nurse could overlook two wards of thirty beds, provided they were on the same floor; but in all other respects the wards should be quite separate.

10. 'No man should be kept on duty in a ward more than twelve hours altogether. Watches of four hours are good, as in the naval service. But this is a question which the proper military authorities alone can decide.

11. 'Twelve hours for the orderly to be off duty are not at all too much.

12. 'On an average, all men and women, after a day of labour, require a good night's rest; in the long-run, and when they do not have it, either health, efficiency, or sobriety, or all three, go.

13. 'A strong man is no exception to the rule; for if made to do night-duty after a laborious day, he will either go to sleep, or drink to keep awake, or he will become knocked-up before his time. It is therefore sound economy to give watchers sufficient sleep.

14. 'You will get more work, and get it longer, out of the man by giving him twelve hours on duty and twelve hours off. It is better for him to have eight than seven hours' sleep; and one or two hours for exercise and fresh air each afternoon, or each alternate afternoon, make a man last longer than going to exercise himself in some tap.

15. 'Supposing regular night-duty required in a ward of thirty men, supplied as above, and served by half a nurse and three orderlies, it might work thus: the principal medical officer will decide whether the same orderly should do the night-duty for a week, or the three on successive nights; probably the latter.

16. 'The orderly might come on night-duty at nine P.M., and remain till nine A.M., thus taking his share in the heavy morning work of cleaning the ward, &c. A large ward got into thorough order by nine A.M. is in very good time.

17. 'A nurse, whether male or female, watching and fasting in a ward from nine to nine, or even from nine to six, would either soon be unfit for duty, or put drams in his or her pocket, or doze through the night. I think, therefore, that a night-ration for night-watchers is indispensable.

18. 'It should be arranged that the nurses who sleep before and after the watch may be enabled to do so quietly. This is by no means always attended to, either in civil or military hospitals.'

19. After describing the uncertain arrangements for nursing in our military hospitals, Miss Nightingale concludes: 'All this refers to things at home, not to war-time, nor to any emergency. Upon each and all these systems, or no systems, it is hardly necessary to make any comments.

20. 'There should be a ward-master for every five or six wards, whose whole business should be to see to the regulations and discipline of the orderlies, and to the enforcing obedience to the orders of the nurse.

21. 'It is obvious that if the nurse is not in authority in regard to all that concerns the patient, her duties will become impossible; but if she is in authority, the orderlies will willingly obey her.

22. 'It should therefore be compulsory that she should report a refractory orderly to the ward-master, or to the captain of orderlies, if such an officer be created.

23. 'The ward-master should be in charge of all returns, accounts, states, diet-rolls, &c., so as to set the nurse completely at liberty to attend to her ward.'

Statistics of Hospitals.

'The sickness to which mankind is liable,' says Dr. William Farr, 'does not occur at any one time or age, but in an interspersed manner over the lifetime of each person. The constant quantity of sickness is kept up by a succession of diseases attacking the body at intervals and in paroxysms, which, however irregular they appear in a limited sphere of observation, are really definite in number, and separated by definite spaces.

2. 'As a certain order is preserved in the performances of the healthy functions, so their derangement, in similar circumstances, also observes an order and regularity of succession.

3. 'To accuse the human frame of perpetual malady is as ridiculous as to attribute, with some theological writers, unintermitting wickedness to the human heart; but if every alteration of the multiplied parts of the human body, every transient trouble of its infinite movements, every indigestion in

man, and every fit of hysteria in woman, were reckoned, few days of human life would remain clear; and if the same scrutiny were extended to the state of the brain, the world may very civilly be sent to Anticyra—*naviget Anticyram.*

4. 'In determining the quantity of sickness, and the attacks of disease, the slighter affections are therefore passed over; as, whatever difference there may be in the representation and expression, it is probable they have a tolerably constant relation, in the same class of society, to the severer cases recognised, and directly diminishing production by putting a stop to labour.

5. 'Men placed in the same circumstances, appear equally liable to an attack of sickness between 11 and 60 years of age; 100 of the London labourers, in each of the decennial periods, 20–30, 30–40, 40–50, 50–60, had nearly 23·5 attacks of sickness annually; the highest number was 26·4, the lowest 22·4. A closer agreement could not, considering the extent of observation, and all the accessory circumstances, be expected.

6. '*The sick time increases with age in a geometrical progression.*—If, therefore, the number of attacks at each age be the same, the duration of each attack will increase in the same ratio; and conversely, if the duration of the cases and sick time augment at the same rate, the number of attacks at every age will be equal. Any two of the elements being given, the third may always be deduced from them.

7. 'Again, if the mortality of the attacked increase at the same rate as the mortality of the entire population, the proportion attacked at every age will be the same. Among the London labourers the mortality between 30–40, 40–50, was 1·48, 2·43, in 100 living; the mortality among 100 attacked was 6·5, 10·4. Now 1·48 is to 2·43 very nearly as 6·5 is to 10·4; and it results from this, that the attacks, whatever their absolute number may be, whether 22 or 52, were the same in both periods.

8. 'We pass over several important applications of these facts to practical medicine, and to practical statistics, where, as in trigonometry, two of the elements of calculation can frequently be measured when the third is only attainable indirectly; expressing a hope, however, that they may be made available in the next census to throw much light upon the sanitary state of different classes of the population.

9. 'External circumstances have the greatest influence on the attacks of diseases; age and the internal state of the body determine their mortality and duration. When the people of this country are placed in destructive agencies, these, like balls in battle, carry them off, by attacking a greater number; they also add to the fatality of the attack; but after a man is seized, age and vital tenacity, exclusively of medicine, are the great modifiers on which his life and sufferings depend.

10. 'In epidemics the attacks generally become much more fatal at the same time that they are more numerous.

11. 'When slighter and ephemeral cases are corrected, and organic diseases are excluded, the duration of cases among the adults does not, according to the returns of the dock-yards, exceed twelve days.'

12. Two reports of a Committee of the Council of the Statistical Society of London on hospital statistics have been published in the 5th and 7th vols. of the Journal of this Society. The information contained in the two reports is elementary and suggestive, rather than conclusive; and of this circumstance the reporters themselves would seem to be aware; for they state that 'the tables which are here brought together must be regarded rather in the light of materials placed in a convenient relation to each other for the purposes of comparison, than as leading to any broad inference; or as being in themselves sufficient for the establishment of any important truths.' Such materials, however, the Committee reports, 'often derive an unexpected value from some enquiry which does not spring directly out of them.' The difficulties and uncertainties here hinted at arise altogether from the want of simplicity and of method in the hospital records. Such being the case, we must have recourse to ascertained principles, and to such facts as may be within reach.

13. Any attempt to extend the present investigation farther back would be but a waste of time, reliable statistics being, even up to our day, hardly attained anywhere in hospital polity. Scarcely anything is known of the death-rate in hospitals during the first half and more of the last century, when, in fact, the hospitals generally throughout Europe were little better than lazar-houses.

14. Dr. Farr, speaking of the public institutions of London, says, that in the quarter ending March 31, 1850, which may be taken as a fair average, 40,783 inmates were contained in them; 'namely, on an average of the two periods given in the table, 3,579 in the military and naval asylums, 670 in military and naval hospitals, 23,972 in workhouses, 3,067 in hospitals for the treatment of common diseases, 3,849 in lunatic asylums, and 5,435 in prisons. Of 10,000 inhabitants, 108 are in workhouses, 24 in prisons, 17 in lunatic asylums, 14 in hospitals; 183 in one kind of public institution or other. In other words, 1 in 93 of the inhabitants are in workhouses, 1 in 726 in hospitals, 1 in 578 in lunatic asylums, 1 in 410 in prison.'

15. This is but a general view; yet even 'the most general view of the public and charitable institutions of one of the greatest cities in the world, cannot fail to be as useful as it is interesting.'

16. 'The fourteen general hospitals of the metropolis,' says the Society's Report, 'admitted into their wards in the course of a year 33,453 in-patients, and treated as out-patients and casual sufferers 313,061 more, making a total of 346,514 patients in a year.

17. 'The thirty-six special hospitals and asylums received in the year 12,355 in-patients, and treated 56,068 out-patients, and, including 19,636 patients not distinctly specified as in- or out-patients, a total of 88,059.

18. 'The general and special hospitals taken together received 45,808 in-patients, and treated 369,129 out-patients, making a grand total of persons relieved of 434,573, including the 19,636 not classed.

19. 'Forty-two general dispensaries give a return of 211,016 out-patients treated in a year.

20. 'The eighteen special dispensaries return 21,862 as the number of patients attended in a year.

21. 'The general and special dispensaries taken together accordingly give a return of no less than 232,878 patients treated either at their own homes or at the institutions themselves, in the course of the year.

22. 'In Paris,' says Miss Nightingale, 'an Annual Report of Hospitals is published; but the only useful statistical information to be gleaned from it is the number of sous each patient has cost. For, although it gives the number of adults, male and female, and of children who have been admitted and who have died during the year, yet this in itself tells little.

23. 'If the hospitals of London and Paris would give us the information contained under the eight following heads, so important would be the knowledge thereby conveyed, that it would be worth while to go back for many years to construct such tables, and to continue the same forms hereafter:

i. 'The numbers admitted for each decennial period of age for each sex per annum.
ii. 'The numbers, similarly arranged, remaining in hospital at the end of the preceding year.
iii. 'The numbers dead for each sex at each decennial period of age per annum.
iv. 'The numbers discharged cured, similarly arranged, per annum.
v. 'The numbers discharged incurable, similarly arranged, per annum.
vi. 'The numbers remaining in hospital at the end of the current year, similarly arranged.
vii. 'The *diseases* remaining, admitted, died, cured, discharged incurable, and remained, for each sex and each decennial period of age, per annum.
viii. 'Duration of cases similarly arranged.

24. 'An ill-constructed hospital will certainly produce a high rate of mortality; but it would be an error to conclude that the death-rate is in every case an

accurate test, since a high rate of death will sometimes proceed from causes independent of structural defects. In a town where people are much employed in machineries and foundries, its hospitals will necessarily receive a larger proportion of severe injuries than those of another town where the labouring classes are differently employed.'

25. 'It is of great importance,' says Dr. Farr, 'for medical men to know the average number of deaths in all cases that come under their care, in order to judge of the remedial influence of medical applications. The hospitals furnish some, although inadequate, information on this head. The sanability of the sick decreases in large cities.

26. 'The rate of mortality varies in the progress of cases to their termination. It has been found that the ratio varies according to a mathematical law; describing a regular curve, which can be calculated; the results observed, and calculated, agreeing with great exactness. The law has been investigated in cholera and small-pox.

27. 'Mr. Edwards first showed, from tables published by Dr. Southwood Smith, that the mortality of the fever patients in the London Fever Hospital, between 15-60, increased every year, at a rate measured by a constant (1·03) discovered by him, and applied to the construction of tables of mortality. He also first announced that if the mortality of all the patients increased in the same ratio, the number at each age between 15 and 60 must be the same; and, moreover, that as the amount of sick time increases as the mortality, the duration of each case will increase in the same ratio.

28. 'After much suffering and much struggling, in the last stages of illness, in weakness and in poverty, great numbers are carried to the London hospitals and to workhouses. The division of the deaths by the population of such institutions for the reception of the sick naturally exhibits a high ratio; and the resulting mortality is very different from that which the whole population exhibits. Thus there are districts in England in which the annual mortality does not exceed 17 in 1,000; in all England the annual rate of mortality was 22 in 1,000; in London, in 1838–44, the annual rate of mortality was 25 in 1,000; in the first quarter of 1850 it was at the rate of 24 in 1,000 annually; in the same quarter, the mortality in the public institutions was at such a rate that if it continued uniform for a year, 230 would die to 1,000 inmates. The mortality was 23 per cent.

29. Referring exclusively to the general hospitals of the metropolis, 'the annual rate of mortality was 82 per cent; in the consumption hospital 82 per cent; in the fever and small-pox hospitals about 302 and 304 per cent; in the lying-in hospitals the mortality of the women and children has not, this quarter, been distinguished. No inference should be drawn from the return in respect to the mortality of particular hospitals; thus, as at King's College Hospital the mortality may be high from patients having been received in a dying state, or from an accidental concurrence of circumstances; or the mortality may be low from the removal of patients in the last stage of illness. It is well known that the mortality is not so high among surgical as it is among medical cases. The mortality in the military was lower than in the civil hospitals.

30. 'The annual rate of mortality in lunatic asylums was 13 per cent. The rate in Bethlehem was 7 per cent; in other asylums the mortality varied from 13 to 22 per cent.'

31. We have recently had much discussion on the mortality of the London hospitals relatively to each other, with comparisons also between these last and the death-rates of the hospitals of Paris; in which, owing chiefly, it is said, to differences of race, constitutional strength, and to the comparatively low diet of the French people generally, sick as well as healthy, the losses are uniformly higher than amongst public patients treated within the United Kingdom. It is found, however, that a comparison of mortality of one general hospital with that of another, within any given city, is surrounded by so many sources of fallacy that no reliable conclusions can be obtained. It is different in the

instances of lying-in hospitals, whose death-rates afford certain materials for comparison.

32. 'We possess,' says the *Lancet*, 'something like a standard by which to judge the normal and unavoidable risk of a woman in childbed. If that standard be much exceeded, the inference that the patients are subjected to some unusual cause of disease is perfectly logical.'

MORTALITY OF HOSPITALS.

What hospital mortality may become through hospital mismanagement, we may learn from many records, civil and military; but chiefly from the records of the British army. In the Crimea alone the mortality was only short of the total loss of the original force, composed principally of old soldiers. Younger men were sent to replace them, but they died in still greater numbers, until measures of sanitary precaution were applied to the camp, the transport, and the hospital. Under neglects of every kind 18,000 men perished, but who might easily have been saved. Under the system of neglect two men died at Scutari out of every five, and one died at Koulali out of every two admitted into hospital. Under proper sanitary regulations the mortality sank to a nineteenth part of these proportions.

2. So sensible was Dr. William Ferguson of the dangers of ill-arranged hospitals, that he declared they would destroy an army faster than any government could recruit it.

3. 'In the infancy of knowledge, when Christian benevolence provided for the sick and destitute, and when it was also the sole foundation of the work, hospitals were built in situations and on plans which were far from realising the intentions of their founders. Mere shelter, food, and attendance were to be afforded to as large a number of sufferers as possible. In times of pestilence, the buildings would be crowded to excess, as we have seen in the case of the Irish workhouses during the famine of 1847. And who can tell how much of the dire loss of human life in the Middle Ages, and during the great Irish calamity alluded to, was due to benevolence misdirected?

4. 'One of the most striking illustrations of the results of absence of knowledge on those subjects is afforded by the experience of the Hôtel-Dieu, at Paris. By the statutes of its founders "all applicants" were to be "admitted." It had 1,200 beds, and towards the end of the last century these beds used to receive, at the same time, from 2,000 to 5,000 sick; and during epidemics as many as 7,000 have been in the building at one time. From 20,000 to 30,000 sick passed through the hospital in one year, about 25 per cent of whom were carried to the cemeteries. In the other hospitals of Paris the mortality was about 12½ per cent of the sick.

5. 'The excuse,' says Miss Nightingale, 'for the enormous mortality of the Hôtel-Dieu was the same as is put forward by ill, and even by many well-intentioned persons at the present day for the high rate of mortality in civil hospitals, and, during war, in military hospitals: viz. that only the worst cases were sent there, and that they were sent only to die. The frightful overcrowding and bad ventilation, with the absence of every sanitary precaution, were, however, the real causes of the catastrophe in the Hôtel-Dieu, just as the frightful overcrowding, and want of ventilation, the defective drainage, and want of cleanliness, were the causes of the catastrophe at Scutari.'

6. Much discussion followed by careful investigations, resulted upon both calamities; and, in the instance of the Hôtel Dieu, eventuated in the introduction into France of vast improvements in hospital construction and management. It will be well if the experiences of our own hospitals shall lead to similar results; and, as to the example of Scutari—and we have had many such—it is to be hoped that its history may also lead to some real and permanent improvements in our military system, as well as in our military hospitals.

7. The truth is that, up to this hour, governments, hospital trustees, and committees, are too apt to conclude that they have done all that is requisite when they have provided 'the very best professional advice and assistance that can be obtained;' and so the enormous mortality of hospitals has come to be considered as unavoidable, merely indicating the percentage of mortality inevitably resulting from disease.

8. 'But nature is never to blame. If the cases be bad as possible, all the more necessity is there for care in placing them where they may have a moderate chance to recover. To place patients in musty wards is simply to kill them, with the addition of torture. The great army-surgeon, Sir John Pringle, knew this quite well when he asserted that hospitals were amongst the chief causes of the mortality of armies. We may safely extend this remark, and say that badly constructed civil hospitals, and other charitable institutions, increase the mortality of towns and districts. We may take for granted, that no hospital ought to yield a mortality on its sick treated of seven to ten or eleven per cent, as is the case with so many of our existing metropolitan hospitals. A certain percentage of death is inevitable, but not a percentage such as this.'

9. Within these few years an enquiry into the comparative mortality of the hospitals in London with each other, and with those of Paris, has been instituted in our medical periodicals; but the difficulties, as shown by Dr. Guy, are such as to render all such comparisons at present useless, or nearly so.

10. From all the calculations that could be made, Dr. Guy states that 'the inhabitants of Paris are more prone to fatal diseases, or that they are exposed to more fatal local influences, or that the two unfavourable conditions are in their case united.

11. 'We may safely assume that the inhabitant of Paris is a worse subject for hospital treatment than the inhabitant of London; and if the hospitals of the two capitals could be on a par in respect of all means of successful treatment, their patients would not enter them on equal terms.

12. 'This, then, is one difference between the inhabitants of London and Paris. Another, and a more important difference, and one which must have a very powerful effect on the hospital mortality of the two capitals, consists in the widely different provision made for the care and treatment of the indigent, the insane, the sick, and the infirm in London and Paris respectively.

13. 'Though the destitute part of the London population is provided for in sickness in the wards of our unions and workhouses, a certain small portion of that very poor population gains admission into our London hospitals. It results that probably one in fifteen of the inmates of London hospitals belongs to that destitute class for which our workhouses are intended; the remaining fourteen consist chiefly of poor persons to whom the term 'destitute' could not be properly applied, and of respectable working men and artisans, with a small number of tradesmen, and a few of better station.

14. 'But the task of providing for the sick poor in the more severe class of maladies is performed by our hospitals in part only; a very considerable number of the worst cases of illness being treated at the homes of the sufferers themselves by the physicians and surgeons of our dispensaries.

15. 'Nor ought it to be forgotten by any enquirer into the mortality of our London hospitals, that the hospitals themselves consist of at least three distinct classes. We have our general hospitals, our class hospitals, and our special hospitals—hospitals, endowed and unendowed, for the treatment of diseases of the more severe class, with few exceptions, and without distinction of sex or age; hospitals for women, for children, for seamen, for foreigners; hospitals for insanity, consumption, cancer, deformities, skin-diseases, and venereal maladies.

16. 'Hence it happens that the wards of a general or mixed hospital present by no means a faithful picture of the more severe accidents and diseases of the population in the proportions in which they occur. Most cases of small-pox are taken to the small-pox hospital; many cases of fever are removed to the fever-hospital; the insane find a hospital and a home at St. Luke's or

Bethlehem; for consumptive cases there are two special hospitals; several special maladies, such as cancer, fistula, diseases of the eye, diseases of the skin, deformities, and venereal diseases, have special hospitals provided for them; and whole classes of the population, such as women, children, seamen, and foreigners, have also their own special hospitals.

17. 'A minute comparison of the mortality of the London and Paris hospitals is neither necessary nor possible. The first and most fatal obstacle to such a comparison is offered by the fact that the Parisian hospitals are the recipients alike of the destitute and of the poor; so that they discharge the twofold function of the London workhouse infirmary and the London hospital.

18. 'A second peculiarity, which is not without effect on the rate of mortality in the two hospitals, is, that the Parisian are supplied by the central administration with cases for which they are compelled to provide accommodation, so that they are subject to be greatly overcrowded in unhealthy years and seasons; while in London the governing bodies of our hospitals are under no such compulsion, and receive a number of patients, determined not by the wants of the population, but by their own resources.

19. 'If to the two leading causes affecting the rate of mortality of the Parisian hospitals are added the two facts, that the hospitals which are best entitled to be considered as 'general hospitals' receive from the central administration those cases in excess which their physicians and surgeons may be most desirous of studying, and that the special hospitals in the two capitals do not admit of being compared with each other, the uselessness of comparing hospital with hospital in the two capitals respectively, or even comparing the aggregate of the two hospitals of the one with those of the other, must be quite obvious.

20. 'The remarks which apply to a comparison between the hospitals of London and those of Paris must also apply to a like comparison between the hospitals of London and those of other considerable European cities. Each city will have its own special arrangements for the treatment of the sick poor; its own special rules for the admission of patients to the benefits of its medical charities.

21. 'Nor is the case greatly altered, except in degree, when we come to compare the hospitals of London with those of our English provinces. Each metropolitan hospital has its own local and its remote sources of supply. It has its accidents and its acute cases from the immediate neighbourhood, and it draws from the environs of London itself, and from more remote rural districts its surgical cases for operation, as well as some of its worst chronic cases for medical treatment. The larger provincial hospitals have perhaps similar sources of supply, and medical and surgical cases of like severity.'

22. The chief considerations, 'and they enable us to arrive at results, highly probable, if not absolutely certain, of the highest interest to all who sincerely desire to understand the true causes of hospital mortality,' will, according to Dr. Guy, be found under the following heads:

(*a*) Locality.
(*b*) Site, and structural arrangements.
(*c*) Space, light, and ventilation.
(*d*) Size of hospital.
(*e*) Medical and surgical cases.
(*f*) Males and females.
(*g*) Selection of patients.

Dr. Guy 'hopes to have an early and more suitable opportunity of establishing by a more considerable array of figures the important fact that the great leading cause which determines the mortality of hospitals is the *selection of patients*—a cause which, at the point of sanitary excellence our London hospitals have now attained, appears to him to be the real determining cause of a high or a low death-rate.'

To demonstrate to the satisfaction of the profession that any one cause (structural arrangement, bad or good, or the selection of patients, namely) will prove the great leading cause, or the real determining cause, of a high or a low mortality in hospitals, is what I fear we may not hope to see speedily effected; but the difficulty ought not to deter us from the prosecution of so important a course of investigation.

Dr. Bristowe and Mr. Holmes, the authors of the Report on the Hospitals of the United Kingdom, comprised in the Appendix to the Sixth Annual Report of the Medical Officer of the Privy Council, have given it as their opinion, derived from personal inspection of nearly all the hospitals in the British islands and in Paris, that the causes of the great difference in death-rates in rural and urban hospitals are to be found chiefly, if not entirely, in the different kinds of cases admitted. A comparison of the admission-books of the hospitals, and of the patients actually in the wards at the time of their visit, has left no doubt on their minds that in country hospitals and infirmaries the medical cases (which at our large metropolitan hospitals are always far more fatal in proportion than the surgical) are, for the most part, trivial or chronic, and furnish comparatively few deaths in hospital. This circumstance, according to them, gives a fallacious appearance of healthiness to institutions which really are less fit places for the treatment of disease than the large hospitals of great cities; but that appearance of healthiness is obtained by neglecting or refusing to provide for the relief of the necessities of the public by the admission of fevers and urgent cases. No public hospital, according to these enquirers, is faithfully discharging its duty, which refuses to undertake the care of those persons who are most in want of it—those afflicted with the gravest form of disease—i.e. the infectious or epidemic maladies. The chief reform, therefore, which they suggest, is the abolishment of the rules whereby the benefits of hospitals are restricted, in a great measure, to the acquaintances and dependents of the subscribers, and the more free admission of fevers and acute medical cases. This reform, however, as they intimate, will be accompanied not by a diminution of the death-rate, but, on the contrary, by its considerable increase. They regard the presence of a low death-rate in any general hospital as a proof, or at any rate a very strong presumption, that such a hospital is failing in its public duty, by restricting its charity to those of the sick who are little in need of it. While agreeing in the main with those sanitary reformers who urge the importance of pure air, cleanliness, and free ventilation, these reporters adduce evidence to show that the number of cases of disease generated in hospital is not large, if estimated by the number of deaths so occasioned, which at all our large metropolitan hospitals form a very insignificant proportion of the total deaths. If this is so, it is idle to expect that any structural improvements, or any alterations in the details of hospital management, would materially affect the broad result—the death-rate. This could only be accomplished by such changes in medical and surgical treatment as would affect the mortality of the diseases treated. The Medical Officer of the Privy Council himself, Mr. Simon, has in the body of the Report expressed his concurrence in the main views enforced in this document, which, he says, 'gives a substantially just relative appreciation of the present hospital-system of this country.'

THE FINANCE OF HOSPITALS.

I had hoped to escape from this subject, as intricate, and perhaps unsatisfactory in its nature; but the question met me at every turn, and I could not avoid it. It will be seen that amongst the best men of our profession, past and present, whether pure philanthropist, or philanthropist and man of business, economy in expenditure has taken the lead in their hospital arrangements. It even precedes the attribute of order. The very existence of an hospital implies a rigorous regard to expenditure; for who can contemplate an extravagant hospital as other than the worst kind of 'Red Lion' for invalids—as a house which must fall on the first day of reckoning. However unsatisfactorily the doctrine that 'economy is the life of the army' may be carried out in practice in this country, certain it is that economy is the only sound life of charitable institutions. It precedes all other considerations. In the history of our military expeditions, hospital finance rises continually into view, either as unworthy parsimony or as enormous and unnecessary waste. The proper regulation of this matter is therefore one of the most important of preliminaries in all hospitals, whether civil or military. The waste of hospital funds is no small part, for instance, of overcrowding, by causing every case of sickness or of wound to linger in hospital so much longer than would otherwise be needed.

2. The sting of hospital finance, as of general taxation, is wastefulness; and there must therefore be a power to control and direct expenditure, and to see that money is well spent.

3. But there is another contingency to be guarded against. Looking to the future, there is some reason to apprehend that even charity may be abused amongst us; that our metropolitan charities may become too numerous, so as to exceed the real wants of the population; that institutions of most excellent design may eventually have to relieve each other, for want of other objects.

4. Of charitable institutions, there are in this metropolis, according to the 'First Report of the Committee on Beneficent Institutions,' about one thousand two hundred; the medical charities alone relieving upwards of six hundred thousand patients, as in- and out-patients of hospitals.

5. The sums contributed for the support of the medical charities of London and Paris are, by one calculation, as follows (the disproportion representing probably the ratio of the two populations):

LONDON.

Income of medical charities	£308,520
Poor-law	842,380
	£1,150,000

PARIS.

Expenses of l'administration générale, year 1853 . . .	£560,853

6. *General Hospitals.*—'The fourteen institutions belonging to this class possess an income from realised property to the amount of 109,687*l.*; annual subscriptions amount to 17,091*l.*; their donations to 16,636*l.*; their legacies to 10,206*l.*; and their miscellaneous sources of income to 1,996*l.* The total income of all these hospitals from every source is 155,616*l.*; and the annual contributions of the public amount to 45,929*l.*

7. *Special Hospitals.*—'There are thirty-six of these institutions, possessing an aggregate income of 117,218*l.*, exclusive of 79,988*l.* comprised in the fifth column of the table, headed "Poor-law relief." Of this sum of 117,218*l.*, endowments and realised property yield 27,140*l.*; annual subscriptions, 12,081*l.*; donations, 28,702*l.*; legacies, 18,993*l.*; miscellaneous sources of income, 15,385*l.*; and sales and contributions by patients or their friends, 11,333*l.* The difference between the sum of these specified sources of income (113,643*l.*) and the grand total of 117,218*l.* consists of sources of income not distinctly specified in the reports of the several institutions.

8. 'It will be seen that the income of the general and special hospitals taken together amounts to 155,616*l.*, added to 117,218*l.* or 272,834*l.*'

9. *General Dispensaries.*—'Of these institutions, of which there are forty-two in number, the income from all sources is nearly 21,000*l.* The exact sum is 20,988*l.*, made up as follows: endowments and realised property, 2,282*l.*; annual subscriptions, 8,777*l.*; donations, 7,746*l.*; legacies, 944*l.*; miscellaneous sources, 126*l.*; and sales and contributions from patients and their friends, 1,113*l.*'

10. *Special Dispensaries.*—'There are eighteen of these institutions, of which the annual income amounts to 8,064*l.*, thus distributed: endowments, &c., 2,098*l.*; annual subscriptions, 3,146*l.*; donations, 1,792*l.*; legacies, 733*l.*; miscellaneous sources of income, 168*l.*; and contributions from patients and their friends, &c., 127*l.*'

11. *Nurses' Training Institutions.*—'These useful institutions, which are auxiliary to our hospitals, have an income of 4,740*l.*, derived chiefly from payments made by wealthy persons for the services of the nurses trained by the institutions. They derive 3,317*l.* from this source; they have 79*l.* of income from realised property; 548*l.* from annual subscriptions; and 796*l.* from donations.'

12. *Samaritan and other Funds connected with Hospitals and Dispensaries.*—'These funds have an aggregate amount of 1,882*l.*, of which 667*l.* is derived from realised property; 159*l.* from annual subscriptions; 758*l.* from donations; and 298*l.* from contributions in aid, &c.'

13. *Poor-Law Medical Relief.*—'The salaries of medical officers and dispensers, and the charges for such drugs and medical and surgical appliances as are occasionally provided by the guardians, in addition to those salaries, amount to 28,776*l.*'

14. *Cost of Maintenance of Pauper Lunatics.*—'This amounts to the very considerable sum of 79,988*l.*'

15. *Vaccination.*—'The sum paid for vaccination—a measure of precaution belonging to a different class of charities from those now under consideration, but not easy to separate from them—is 4,229*l.*'

16. *Summary.*—'The annual income of the several medical charities, of such portion of the medical relief under the Poor-law as admits of separation from the general expenditure, of the cost of maintenance of pauper lunatics, and of vaccination, amounts, as will be seen by the following tabular statement, to 423,668*l.*; of which 310,604*l.* consists of voluntary contributions, and 113,056*l.* of sums raised by rates.'

17. 'General hospitals		£155,616
Special hospitals		117,218
Total hospitals		£272,834
General dispensaries		21,000
Special dispensaries		8,064
Total dispensaries		£29,064
Nurses' training institutions		4,740
Samaritan and other funds		1,882
Total of voluntary contributions		£308,520
Poor-law medical relief	£28,776	
Pauper lunatics	79,988	
Vaccination	4,292	
Total raised by rates		£113,056
Grand total of voluntary contributions and rates		£421,576.'

18. 'Of the charitable contributions properly so called, about 142,000*l.* is derived from realised property; about 41,000*l.* from annual subscriptions; about 52,000*l.* from donations; and about 31,000*l.* from legacies.

19. 'If the population of the metropolis be taken at 2,500,000, the voluntary contributions to our medical charities, including the income derived from realised property, will be at the rate of somewhat less than 2*s.* 6*d.* per head. Taking the same basis of calculation, the annual subscriptions will be at the rate of less than 4*d.* per head, the donations of about 4*d.* per head and the legacies of nearly 3*d.* per head. But if allowance be made for contributions from persons who are not resident within the limits of the metropolis, even these small sums will have to undergo some abatement.'

20. While treating of hospital finance, it is proper to state that the funds of our medical institutions are said, by persons who speak advisedly, to be in course of constant abuse from the admission to their benefits of persons who, by their position and superior means, are undeserving of any charitable relief.

21. To demonstrate the fact, it is only necessary to state that forty-five millions sterling are annually expended, by the labouring classes chiefly, in the purchase of spirits and tobacco! while it is well known to the medical officers of our hospitals that a goodly percentage of the patients derive succour fraudulently, and to the prejudice of the interests alike of the medical officers and of the subscribers to our charities.

22. That the means possessed by daily-increasing classes of labourers and artisans are sufficient, in their years of health, to provide for the necessities of their hours of sickness, and for the infirmities of age, is proved by the readiness with which they join the Benefit-Societies established by public companies and private establishments.

23. By ill-regulated and indiscriminate modes of medical relief, we teach habits of improvidence to the class of labourer and mechanic, and eradicate from their minds the noble characteristic English attribute of self-reliance and self-respect. We do more: by holding out promise of succour, under diseases engendered by debauchery, we encourage the national vice of drunkenness.

24. Our medical charities were not established for the reception of absolute and unredeemed paupers; yet a large proportion of the out-door relief given by our hospitals and dispensaries is thus wrongly diverted. Through want of food and its resulting diseases, they seek for aid, and receive cod-liver-oil, sago, and arrowroot; while the Poor-law relief, which is their proper due, is withheld.

25. 'Yes,' says the *Medical Times and Gazette*, from whose excellent articles these observations are quoted, 'these charities are a sort of sluice, into which the Poor-law authorities turn a large amount of parochial misery, instead of honestly providing for it. What do the bills for cod-liver-oil consumed by this class of paupers in our charities really represent, but so much food, paid for by the governors instead of by the ratepayers?'

26. Under a system better ordered, the mechanic, instead of spending the superfluous part of his wages in drunkenness, and in the production of the many diseases which drive him into hospital, would then become an independent man, receiving what in part he had already paid for, and had a right to claim.

27. 'A long experience,' says the editor already quoted, 'has shown to us that the classes of whom we speak are willing and ready to pay the small sum demanded of them—a sum which would equal half the present expenses of our hospitals and dispensaries—provided they could thereby obtain the superior kind of advice they suppose to be had at hospitals.'

28. The relief which can be very easily obtained is seldom valued; and this truth applies in an especial manner to the indiscriminate out-door relief which offers food of insufficient nature and amount, in the shape of medicine, to starving paupers.

29. Three great endowed London hospitals are mentioned * as possessing each an annual revenue, rapidly increasing, of 40,000*l.*—thus placing at their joint disposal 120,000*l.* per annum. The three institutions together promise a maximum of 1,700 beds; requiring for the annual maintenance of each bed 30*l.*, or an aggregate of 50,000*l.*

30. On this calculation, the large sum of 70,000*l.* is left to be annually applied to the relief of about 200,000 out patients; each of them costing the institutions about six shilling a-head—an extravagant sum for this department of service. This system requires revision, lest it degenerate into a waste of the revenues of those great charities, crippling their usefulness in other and better directions.

CONVALESCENT HOSPITALS.

No system of hospital arrangement, national or metropolitan, civil or military, can be regarded as in any way complete, which does not comprehend the supplementary establishment of convalescent hospitals. All who are acquainted with our civil hospitals, especially with those in crowded cities, know how many patients return home to die, for want of an asylum where convalescence may be promoted and matured into health—where pure air, gentle exercise, and regulated diet may complete what the surgeon and the physician have begun. In our hospital arrangements, it is to be feared that we have been trusting too much to drugs, and too little to the influence of pure air.

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* *Medical Circular* of February 27, 1860.

2. There are notices of remote date in various countries, as Spain and France, of convalescent establishments as attached to, and for the relief of, general hospitals; and we find excellent notices, although not of so early a date, in our own country, such as those of a Society established, in 1791, in connection with the London Hospital. They were founded on the works of Howard the philanthropist, and the principle of their institution professed to be: 'Take care of him; and whatsoever thou spendest more, when I come back, I will repay thee.' Here we have, in fact, the principle of all sanitary arrangements, which, by a universal and beneficent law, repay themselves; a result so beneficent that it should be ever kept before the public eye.

3. Charity should not be exclusive or limited in its application to distress, nor should its objects in relation to disease fall short of a complete restoration to health. Hospitals are a practical example of that charity which has been compared to the bounty of Heaven, and to the hand of the Creator, which is never closed.

4. By charity we understand a virtue which, like generosity, supposes the sacrifice of personal for foreign interests. Charity is not only a duty of humanity, but more; one of the most pointed obligations of society towards some of its members, to whom it owes everything, when they can do nothing for themselves. This is not said with the view to deprive governments of their merit when they occupy themselves with public charity; on the contrary, to speak of the duties of governments is to show them, if not the only, at least the most solid, title of their glory.

5. All we can wish, as regards the poor, is, that they accept and enjoy, without the fear of humiliation, the succours which charity offers them; and for this it is only necessary that they know they have a right to those succours.

6. It is doubtful if any estates were ever devised, or any money bequeathed, which bore richer fruit or produced greater blessings than hospital endowments. When it is remembered that in those establishments any poor invalid or sufferer, with no claims but his sufferings, finds the best treatment, the best food, the best advice that can be given—all indeed which the most unbounded wealth could buy—it will be seen how truly they reflect honour upon the country.

7. But hospitals are not complete or perfect any more than other human institutions; and one of the greatest wants of our noblest institutions must be reckoned the absence of convalescent establishments. The 'desperation,' the natural craving for 'variety,' so graphically described by Miss Nightingale as characteristic of all sick persons, must of itself have proclaimed to the observant physicians of all ages and countries the necessity for convalescent hospitals; that is, for a relief from the horrors of the hospital miasm of the great town system. Miss Nightingale's description of the labouring man who was desperate 'to see once more out of window,' and who got on the nurse's back 'to see out,' is demonstrative of a physiological truth, because it is an instinctive impression. The desire for change, for change in everything, physical and moral, which is implanted in our nature, is increased a thousandfold by sickness; and the denial of this instinctive craving is unquestionably a most powerful cause both of retarding convalescence and cure.

8. 'An hospital,' says Dr. Rollo, of the Artillery, 'should be regarded as a place exclusively devoted for the reception and treatment of the sick and wounded; but when convalescence arrives, a change of place and of management becomes necessary to the advancement and reëstablishment of health.

When the sick begin to feel the dawn of health, the mind becomes sensibly changed, and disgust takes the place of accustomed associations and modes; and hence a disposition is formed inimical to recovery. When this stage arrives, if they are removed from hospital to the place of convalescence, where they are to associate with different persons, to engage in other and new manners, and to be sensible of a complete change of scene and of habit and accommodation, the recovery advances rapidly, and proves complete. These observations apply to any description of sick; but more especially to the soldier.'

9. Convalescent hospitals are spoken of by Donald Monro as in general use throughout the army in his day, and he lays down excellent rules for their management. How this inestimable aid fell into disuse in the army does not appear. Robert Jackson, writing in 1803, recommends 'separate and detached houses,' and the removal of convalescents 'to other apartments or hospitals.' He adds that innumerable proofs occurred in his experience of soldiers 'recovering health better and sooner in sheds, huts, and barns, exposed occasionally to wind and rain, than in the most superb hospitals in Europe. Pure air, in this respect, is alone superior to all forms of cure, and to all other remedies without such aid.'

10. This great author everywhere speaks of 'relapse as the leading cause of mortality in general hospitals. . . The effect of accumulation is evidently to corrupt the air, and thus to generate an artificial malignity; life is lost, and the cure is protracted; independently of which the military qualities of the surviving soldier, as depending on discipline and impressions of energy from example, are impaired, if not totally destroyed.'

11. In hospital the soldier is under a necessary restraint; and were he discharged from it immediately on the subsidence of disease, to inhabit the common barrack, he would feel and act as the schoolboy at his vacation, and enter with all the recklessness of his nature into enjoyments the most injurious to his health; and hence frequently those relapses so much more dangerous than the original disease.

12. The convalescent hospital is therefore a stage in the process of cure, intermediate between the hospital and the home of the citizen and the soldier. In either case the sick and convalescents are gradually and surely brought back to their habits of health, and the duty of the physician, whether civil or military, is duly performed.

13. In the convalescent hospital there must be separate and equally well-ventilated apartments for the refreshment of sleep and for that of meals, besides covered ways for exercise in bad weather, and open spaces for exercise in fair weather. The scale of diet must also rise with the advance towards health.

14. The miasm was so concentrated in some of the Italian hospitals that, out of fear of its effects, convalescents were not deemed safe in their neighbourhood; the patients were therefore sent into the country and lodged in separate houses. Where practicable, a certain number of convalescent hospitals should be constructed on the seaboard.

Postscript.—Perhaps the most complete institution of the kind here referred to is that founded in August 1857, at Vincennes, by the Emperor Napoleon III., and which contains 411 beds. The edifice is composed of a main building, with two long wings, two stories high, with a ground-floor. It has ample garden-ground, basins, and jets-d'eau.

2. In the first two years and ten months of its usefulness this hospital had administered relief to 14,000 convalescent artisans.

3. The central pavilion, Dr. Véron states, contains, on the ground-floor, the chapel, and to the right and left airy dining-halls, having marble tables, commodious seats, and simple service reduced to necessaries. Every object in these refectories is bright with cleanliness.

4. On the first-floor of the central building are the library and play-room; the two wings of the edifice in both stories being subdivided into rooms, each of

three beds, all neatly furnished, and looking to the south. Each patient has the use of a press, with lock and key.

5. Everywhere open air and sun are freely admitted; and even in the storehouses permanent ventilation is maintained; consequently nowhere, even in the best houses, is linen to be found drier or fresher than at the asylum. It is completely inodorous.

6. The convalescents belong to the following categories:

(*a*) To the hospitals of Paris and its suburbs.
(*b*) To charitable boards.
(*c*) To convalescents from wounds received in the public dockyards.
(*d*) Members of benefit-societies.
(*e*) Operatives from establishments paying subscriptions, and whose directors are authorised to send their convalescents to the asylum.
(*f*) Artisans treated at their own homes on presentation of certificates of convalescence by their medical attendants.

7. The mean duration of the stay at the asylum is twenty-two days. Convalescence from typhus fever is comparatively short, in consequence of the hygienic resources of the institution.

8. In principle, the convalescent remains at the asylum until he is completely restored to health, or declared incurable.

9. The diet is regulated by the director and head-physician of the establishment, the habits of the artisans being adhered to for the hours of meals.

10. At 7·30 A.M. soup is served; and at 10·30 meat and vegetables. At 5 P.M. soup, roast meat, vegetables, and salad or dessert are served: each convalescent receiving a pint of Burgundy wine, and as much bread as he may choose. The head-physician modifies this diet whenever he thinks fit.

11. When convalescents desire it, they are employed in the establishment, receiving wages of from two to five pence per day, and an extra allowance of half-a-pint of wine. Some thus lay by a small sum which proves a useful resource on leaving the asylum.

12. The allowance for food for each patient per day is 11*d*., exclusive of the general expenses and of firing; the daily cost of medicine for each convalescent averaging $\frac{3}{10}d.$

13. The medical service is complete, and comprises common baths, sulphurous, saline, and vapour baths; the administration furnishing also bandages and such other apparatus as the convalescents cannot afford to purchase.

14. On arrival, and being examined by the house-surgeon on duty, convalescents receive the clothing and linen of the establishment, which usually comprise shirt, greatcoat or smock-frock, socks, nightcap, a cloth cap or straw hat, a napkin, towel, and handkerchief. The linen is changed every Saturday, being washed and ironed in the asylum.

15. A wash-house is established on Bouillon-Müller's system, and comprises a five-horse-power steam-engine, wash tubs, coppers, a cold-water boiler, a centrifugal-force drying-machine, hot-air drying-rooms for winter, and a drying-field in the open air for summer.

16. Unoccupied convalescents find numerous means of diversion; they have at their disposal skittles, balls, drafts, dominoes, loto: cards are prohibited.

17. The library is open every day from 12 to 4, and contains 4,000 volumes and the illustrated journals. The greater part of these books were presented by the Paris booksellers as donations. On the average there are 50 readers a-day; and there have been as many as 96.

18. The bearing and general conduct of the inmates is exemplary; submitting without murmur to the regulations, being polite to each other, and respectful to the officers of the establishment. They are careful of the furniture, garden-flowers, &c., and keep their rooms and passages in great cleanliness.

19. The officers of the asylum of Vincennes are—a director, treasurer, head-physician, and three house-surgeons; six nuns of the Order of St. Augustin of Belgium; a chaplain, five clerks, a store-keeper, four overseers, and forty subalterns.

20. The head-physician has the charge both of the medical and surgical departments; and upon his and the directors' nomination the house-surgeons are appointed by the Minister of the Interior.

21. Sunday, Monday, and Thursday are the days on which relatives and friends are allowed to visit the convalescents; and the parlour or garden may be used for this purpose.

J. R. MARTIN.

SURGICAL INSTRUMENTS AND APPARATUS.

THIS essay on 'apparatus' does not pretend to be a complete enumeration of modern surgical instruments and appliances. There is no space for such an enumeration, nor would it be compatible with the objects of the present work. The series of observations on instruments generally, which follows, is intended merely to put before the reader such as appear best calculated to effect, in skilful hands, the desired objects.

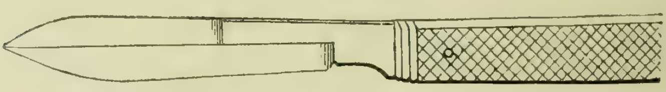
It may be remarked that proper names are rarely introduced as applied to instruments. Such a practice leads only to dissatisfaction and argumentative claims for priority of invention. The reader, however, may be assured that our surgical forefathers were not idle—and that many a so-called novelty may find its prototype in the past.

The objects here sought are to afford the surgeon plain and practical rules for guidance in the selection of instruments. Very many varieties, however, will be found mentioned in the several essays which form the foregoing system of surgery, by their respective authors, whose names are a sufficient guarantee for the soundness of their advice and opinion.

Pocket-case.—A surgeon's pocket-case should, for convenience, be as light as possible; but must contain instruments required for general use, namely, two broad scalpels (one double-edged) fitting into a single handle; two curved bistouries (one blunt-ended) similarly set; a pair of scissors, a spatula, two lancets, two probes, a director, a pair of dressing forceps, a pair of artery-forceps, a tenaculum, a gum-lancet, a female catheter, and a caustic-case.

The scalpels are used commonly for opening abscesses, such as those which form in the deep-seated structures of the neck, in the palm of the hand, by the side of the rectum, &c.; and inasmuch as it is desirable to let out the matter effectually, with as little pain to the patient as possible, so the knife should be sharp-cutting, thin, and broad, that it may enter and divide the soft parts swiftly and easily, and make with one plunge an opening nearly sufficient in extent. When a small knife is used, the enlargement of the opening is effected by a succession of movements, which leave a jagged wound. Let it also be remembered that it is the size of the abscess, and not the age of the patient, which determines the breadth of the knife. The usual scalpel may be as freely used in an infant as in an adult. The scalpel with a single cutting edge is rarely used, for in operations of magnitude a special set of instruments

FIG. 430.



Scalpel for opening abscesses. (From Maw's Catalogue.)

is required. Still it may be needed, and should form part of the usual pocket-apparatus.

The scissors should cut well to the point. Some surgeons carry two pairs—one for plasters, the other for operations. Those for the former purpose may be made with the blades bent at an angle.

In the surgery of hospital practice, the curved bistouries are required generally for slitting-up unhealthy sinuses proceeding from badly-managed suppurating buboes; for dividing the contracted prepuce in sloughing ulcers of the glans penis; for laying open a fistula in ano, &c. Care should be taken that these instruments be sharp.

Bleeding-lancets are not often required for the purpose intended by their name. Venesections in the spring of the year have grown out of fashion, together with the biennial exhibition of purgative medicines. A bleeding-lancet is now mostly used for opening very small abscesses, for vaccination, &c.; and no surgeon should be without two or more of such implements.

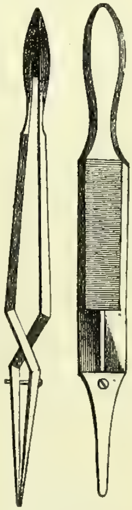
Probes are usually made of silver—the reverse end of one being sharp, that of the other having an eye; but a steel probe is a useful instrument: it is firmer when used for the examination of carious bone, or for the search after foreign bodies.

A director is usually made of silver, the handle end being flat and sometimes fissured. This fissure was used by the older surgeons to protect the ranine artery in division of the frænum linguæ. A flat steel director, as invented by Mr. Wormald, is a useful instrument in the division of very tight strictures, such as that of Gimbernat's ligament in femoral hernia, and may be added to the case.

The dressing-forceps should be made much stronger than the common ones, inasmuch as they are required for the removal of pieces of dead bone, or for grasping foreign bodies, when the exercise of considerable force is necessary.

There are many varieties of artery-forceps, the greater number of which profess one and the same object—that of holding the bleeding vessel by some spring or catch, so as to allow the surgeon, when without an assistant, to have both his hands at liberty to apply the ligature. One of the most durable instruments is fixed by a slide-bolt; another, on the principle of Assalini's forceps, closes by a spring; (Fig. 431) a third, opens with a spring, the blades being held together, when grasping the vessel, by means of a catch. Of these, perhaps, the last is the most handy. It is particularly useful in the performance of the operation of harelip. The minutest piece of the lip can be held surely and firmly while the requisite incisions are being made.

FIG. 431.



Self-closing artery forceps.

Dieffenbach's small artery forceps (Fig. 432.) may be used with advantage to close temporarily the open orifice of an artery during the course of a prolonged operation. Four or more of these small instruments, which close by a spring, may, when properly applied, completely arrest the flow of blood, and thus render more easy a difficult dissection.

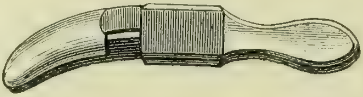
Acupressure.—As a substitute for the ligature applied to an artery to restrain bleeding, the late Sir James Simpson of Edinburgh has proposed the employment of a needle to close the bleeding vessel by pressure till a coagulation-clot has been formed.

In using the ligature, the part of the artery and any of the soft structures enclosed are necessarily strangled, and die before it can be disengaged. For periods varying with the magnitude of the vessel, the ligature remains as a foreign body; excites by its presence ulceration of the artery just above the constriction; imbibes and retains fluids which may decompose, be reabsorbed, and contaminate the blood.

For all these reasons its presence in a wound is said to be prejudicial to union by adhesion, and to organic closure of the vessel and, in addition, it increases the risk of purulent infection of the vital fluids.

Metallic surfaces are practically impervious to moisture; and, as a matter of observation, it has long been known that metallic substances may be introduced and lie imbedded in the soft structures of the body for an indefinite period, without producing suppuration or even irritation.

FIG. 432.



Dieffenbach's artery forceps. (Maw's Catalogue.)

Again, it is a matter of observation that by pressure sufficient to interrupt the stream of blood through an artery for some hours, its channel becomes occupied by a clot of blood reaching as far as the mouth of the next considerable branch given off from it; and that, under favourable circumstances, this clot, it is said, may be organised, and permanently close the vessel.

From these data Sir J. Simpson concluded that it was feasible to pass a needle through the soft structures in such a manner as to press upon an artery divided at some distance from any collateral branch, and so close its channel till the surgeon considered he might safely withdraw it, and leave to nature the complete obliteration of the vessel.

For this purpose he proposed to use the needle in any of the three following modes:

1st. By passing a *long* needle through the soft parts on each side of an artery, so as to cross over and compress it in the same way as in fastening a flower, by means of a pin passed over its stalk, in the lapel of the coat. The needle should have a glass head for facilitating its introduction and removal; and when inserted the head must be outside the wound.

2nd. A *short* common sewing-needle, armed with fine iron-wire, is dipped down into the soft textures a little to one side of the vessel, then raised up and bridged over the artery, and again thrust into the soft tissues on the other side. The iron-wire serves to withdraw the needle, and is to be carried outside the wound.

3rd. A *short* common sewing-needle, armed with iron-wire, is passed through the soft part on each side of the artery, and immediately *behind* the vessel, for a point of resistance; the head and point of the needle are to project so as to allow of the wire being carried *over* the artery, turned round the needle's point, and returned to its head, where it is to be fixed by a twist. In this way the artery is pressed between the needle and the loop of wire. To remove this, the needle may be withdrawn after cutting the wire near its eye; the loop, being disengaged, may then be easily pulled through the wound.

Very little pressure is required to control bleeding, even from one of the large arteries; the surgeon should therefore avoid undue obliquity in passing the needle, lest it produce ulceration of the coats of the artery, and of the soft textures in its track.

As yet, probably no definite rule can be suggested as to the period when the needle should be removed; but it seems that a few hours' pressure will suffice for such arteries as the radial or ulnar, and when applied to the femoral, in amputation of the thigh, for about fifty hours. In a case reported by Mr. Crompton, secondary hæmorrhage occurred after seventy hours' pressure; and after death it was observed that the femoral artery was quite empty to the point of constriction. The patient died of pyæmia.

Acupressure has proved successful in the practice of many surgeons when employed in the larger amputations; and, it is said that secondary hæmorrhage has been more uncommon after it than when the ordinary ligature was used. Acupressure has been extensively practised in the different metropolitan hospitals; but I have seen no possible advantage that it possesses over the ligature. Many of the dangers stated to attend the use of the ligature are purely imaginary.

Diagrams of the various methods of acupressure will be found in vol. i. p. 728.

The female catheter is a necessary addition to the pocket-case, since retention of urine sometimes complicates operations performed on, or in the neighbourhood of, the pelvic organs; and the catheter may also sometimes perform the part of a sound in detecting the presence of foreign bodies. Retention of urine does also sometimes occur from injury to the urethra, and occasionally, though still more rarely, from organic stricture. The introduction of instruments, however, in hysterical retention, is injurious and objectionable, and has been reprehended in the essay on HYSTERIA, vol. i. p. 383. In introducing the catheter in an adult, it is desirable in ordinary cases to avoid any exposure of the patient's person; and there is usually no difficulty in finding the meatus without any such exposure. On passing the finger down below the clitoris, the projection of the meatus is easily felt just above the entrance of the vagina. The index finger of the left hand should be placed below this projection, and the catheter, glided along the finger, will find its way into the meatus. In children there is not the same objection to exposing the parts; but if the surgeon prefers to pass the catheter beneath the clothes, he must remember that the urethra appears to be situated much farther back, in consequence of the relatively small size of the vagina.

Of the other instruments—tenaculum, gum-lancet, and caustic case—the last only merits remark. The metals best fitted to hold the caustic without corroding are palladium or gold. The former lasts extremely well. Sometimes a small trocar is fitted to the reverse end of the caustic-case; but to this there is an objection that it is very apt to rust, and to cling so tightly to the minute canula that it cannot be used.

Finally, a surgeon's common pocket-case should be made to close by any other means than a spring-clasp, which always gets out of order. A single pocket is sufficient for ligature-silk (of which there should be two or three varieties) and needles, which should be sharp and of different sizes and curves.

Those who have to visit patients in outlying districts may have a male catheter added to the above. It should be of the size of No. 6, and separable into two pieces, which are united by means of a hollow screw lying in that portion which would be called the handle. A piece converting the handle into a female catheter is made of the same gauge.

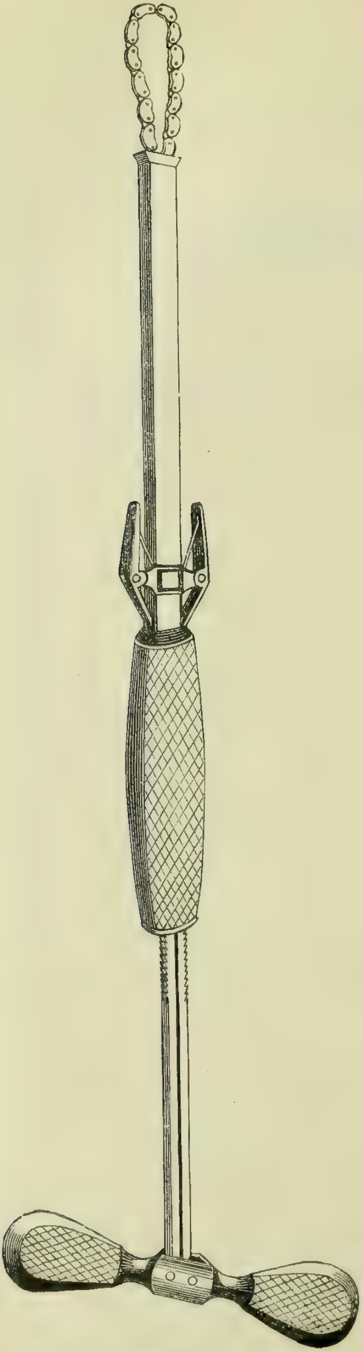
If the pocket-case contain more than the above, it becomes inconveniently heavy. The instruments should be so arranged that they do not press against one another when the case is closed; for then an accident is apt to produce marks and indentations on silver instruments, such as a catheter or caustic-case, and occasionally to render them unfit for use.

Many cases occur in which it is desirable to explore the interior of a tumour; and for this purpose a grooved needle, enclosed in an ivory case, is made so as to be fitted into some convenient part of the case, perhaps where the pencil was supposed to be.

In some hospitals the surgeons are fond of using a small knife, not unlike a tendon-knife, in doubtful cases of abscess. It goes by the name of 'Pollock's abscess-knife.' It is a very narrow-bladed, but not very thin, scalpel, double-edged for a very short distance from the point, mounted in a little tortoiseshell handle, with a spring: it takes very little more room than a lancet. It is so small that an exploratory puncture can be made with it, and yet strong enough to make a tolerably long and deep incision.

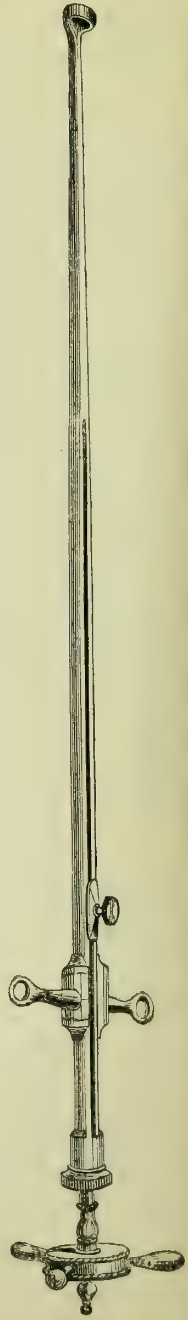
The *écraseur* of M. Chassaignac (Fig. 433) is a long steel instrument containing a chain, which, passed round the base of any structure, gradually constricts it, and slowly tears through the compressed tissues by means of very simple machinery worked at the handle. When used in properly-selected cases, it

Fig. 433.



The écraseur.
(From Maw's Catalogue.)

Fig. 434.

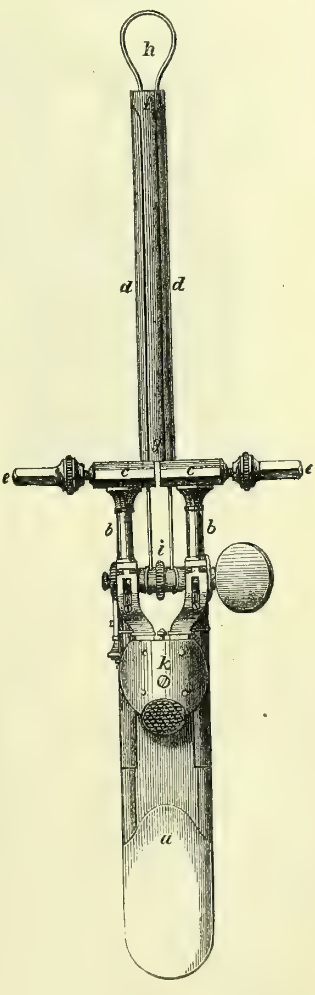


Écraseur for nasal polypus.
(From Maw's Catalogue.)

possesses many advantages. It may remove a large tumour without the occurrence of hæmorrhage; for torn and compressed arteries do not bleed. It may cut through the base of a polypous growth, in cases where the employment of the knife would be dangerous; and, by removing the morbid structure, it may spare the patient the discomfort and risk attending the separation of the constricted parts by sloughing. *Ceteris paribus*, the employment of the knife is preferable as being quicker. The chain of the écraseur unfortunately bears only a certain amount of pressure. Beyond that point it will snap, when the operation must be discontinued. This accident happens not uncommonly in operations on large fibrous tumours of the uterus. The gradual pressure of the chain renders the neck of the tumour harder and harder until it resists all further impression, and breaks the chain or cord by which it is constricted. Smaller varieties of the écraseur are made for operations in the nose, &c. (Fig. 434).

The best form of instrument is that which works with a handle at right angles to the shaft of the instrument. As the right or left half of the instrument is depressed, one link of the chain is pulled into the case. The great object is to work slowly, one quarter to half a minute intervening between the successive movements; but it is not necessary to abide by this rule, unless the resistance be considerable. Another form of the écraseur is supplied with a handle like a ship's wheel. The shaft may be straight or curved; the chain may be of different sizes.

FIG. 435.



The galvano-caustic cutting-noose.

The galvano-caustic 'cutting-noose' (Fig. 435) is made of platinum wire, which is passed round the neck of the part to be removed; next rendered burning hot by being attached to a galvanic battery; and finally tightened by a screw, so as to cut through the soft parts. The instrument here represented is ten inches long, and is composed of a broad ebony handle of four inches long (*a*). From this proceeds two batteries (*b b*), each of which has attached to its anterior extremity an octangular transverse piece (the capital, *c c*). These receive the tubes (*d d*) vertically, and the lateral pieces (*e e*) horizontally; and these latter are attached by the quadrilateral extremities to the conducting chains. The ligature-tubes (*d d*) are 2½–6½ inches long, and 1 inch broad; straight or bent; and isolated by means of a piece of ebony (*f g*) inserted between them. This piece of ebony should send a tongue-like prolongation to isolate the two capitals (*c c*), and end in a head (*f*), which is perforated for the ligature-tubes. When the piece (*k*) is drawn backwards, the transverse bar (*i*), to which the platinum wire is attached, can be taken out.

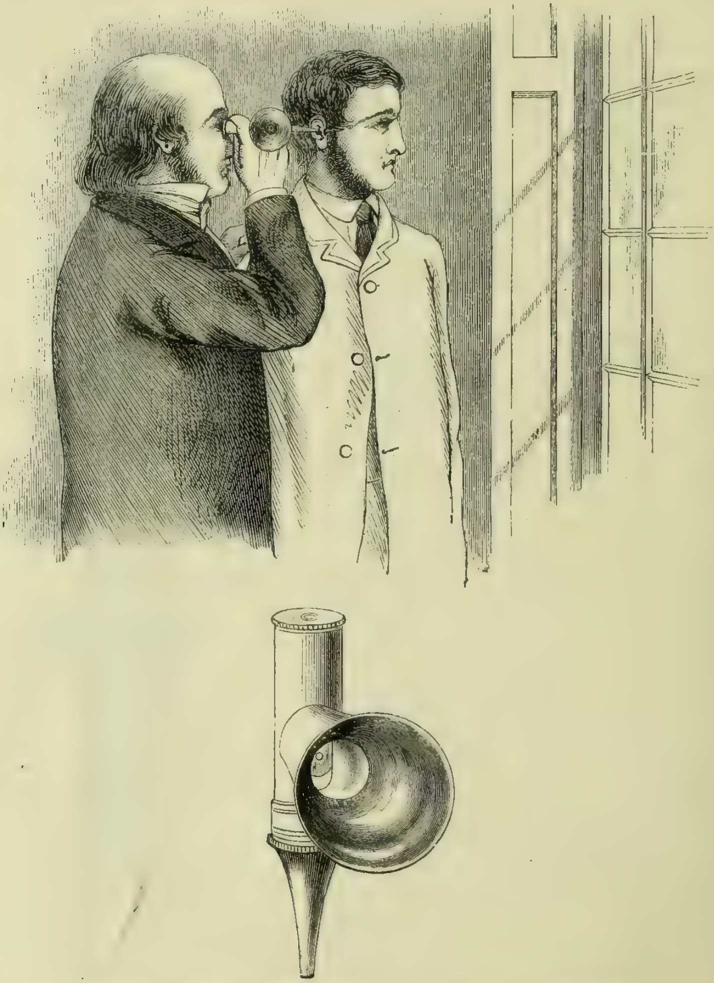
Among modern instruments for including within a ligature the base of a tumour is Maisonneuve's apparatus, which works by means of a long screw in the centre of the handle.

Needle-holders, by Bruns and Lüer, have been recently exhibited, of ingenious construction, the blades becoming closed as the handle is withdrawn within the canula.

Polypi-forceps of great strength have been constructed. In some the handles are fixed in a catch as they are closed, and the operator has thus both hands free, if he so needs. (See Fig. 463, p. 1085).

Aural instruments.—In order to examine the meatus auditorius externus, it is generally sufficient for the surgeon to raise the concha with the left hand while he presses back the tragus with a stout probe, the patient sitting with the side turned towards the light. But a very complete ear lamp-and speculum have been devised by Brunton (Fig. 436), in which the light is thrown into the instrument by an aperture in the side.

Fig. 436.



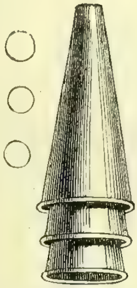
Brunton's ear-lamp and speculum. (From Maw's Catalogue.)

Wylde's ear speculum is a convenient and useful little instrument (Fig. 437).

An instrument has been constructed for the purpose of removing foreign bodies from the ear. It consists of a straight piece of steel about the shape and size of a small director. The tip of the instrument is made to bend downwards to a right angle, when acted on by a screw at the handle. The principle consists in passing the instrument down the meatus auditorius, until the point has passed the foreign body. The depression of the tip then converts it into a sort of hook, which will readily serve as a means of traction. But, as has been shown in another place, foreign bodies, if they do not act as sources of irritation, may be allowed to work their own way from the auditory passage.*

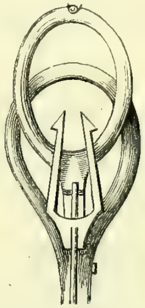
Instruments for operating on the enlarged tonsil (Fig. 438).—In the present day an instrument called the guillotine is mostly used for this operation, and it accomplishes its object perfectly. There are two varieties. One, the original, which cuts from before backwards; the other, of later date, which cuts in the opposite direction. The principle is the same in both. A steel frame is grooved so as to allow passage for a knife, shaped as the guillotine-knife. The end of the frame is slipped over the tonsil, the projecting part of which is seized with a hook; the knife is then pushed backwards to the end of the frame, cutting through the tonsil in its course. The only accident which can occur is that the piece of severed tonsil may become detached from the hook, and slip down the patient's œsophagus. The steel frame may contain a thin curved knife at its end, concealed within the apparatus. A double movement, effected at the same moment, enables the surgeon to plunge a harpoon-shaped hook into the tonsil by the pressure of the thumb, while he draws the thin semilunar knife from behind forwards through the tonsil by the action of his fingers; and the operation is completed in a second. The first instrument requires three periods for its use: first, passing it over the tonsil: secondly, fixing the tonsil with a hook; thirdly, cutting the gland with a knife. The second instrument requires but two periods: first, slipping its end over the tonsil; the insertion of the hook and the action of the knife are simultaneous. Both are instruments of great merit; the former being American, the latter French. Of the two, the latter is more complete, because more speedy in its action.

Fig. 437.



Wylde's ear speculums.
(From Maw's Catalogue.)

Fig. 438.



Tonsil Guillotine.

The instruments used in operating for *hernia* have been already described (vol. iv. p. 714).

Amputation-case.—No great improvements have been lately made in the instruments contained in an amputation-case. The contents consist of knives of different sizes, including the catlin, a tourniquet, saw, artery-forceps and bone-forceps, scissors and ligatures. Of the knives it may be remarked that they should be straight, moderately broad, and not too long, lest they be unmanageable. A small amputating-knife is preferable in operations at the lower third of the leg, or at the ankle-joint, the foot, or arm. A similar instrument is desirable in reflecting back a semilunar flap of integument, or in the performance of Mr. Teale's operation of the rectangular flap.

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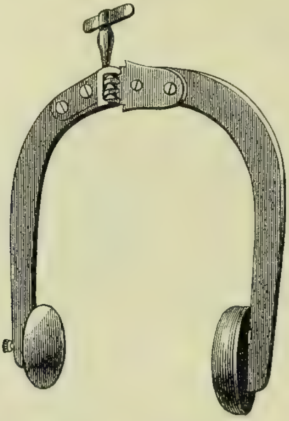
* Vide essay on Injuries of the Face.

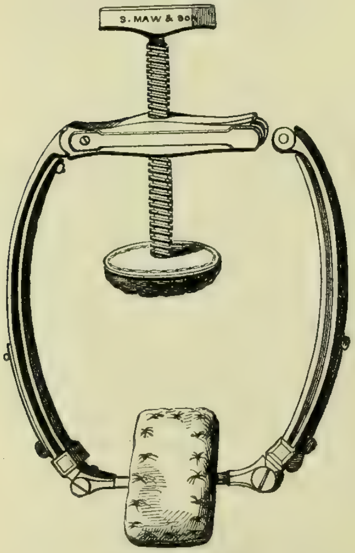
FIG. 439.



Signoroni's tourniquet. (From Maw's Catalogue.)

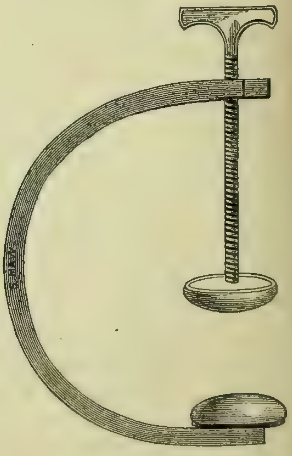
The screw tourniquet may be improperly applied for want of attention to a simple rule. The screw which tightens the bandage must be *precisely opposite* to the pad which presses on the artery. If it be not so then at each

FIG. 440.



Skey's tourniquet.
(From Maw's Catalogue.)

FIG. 441.

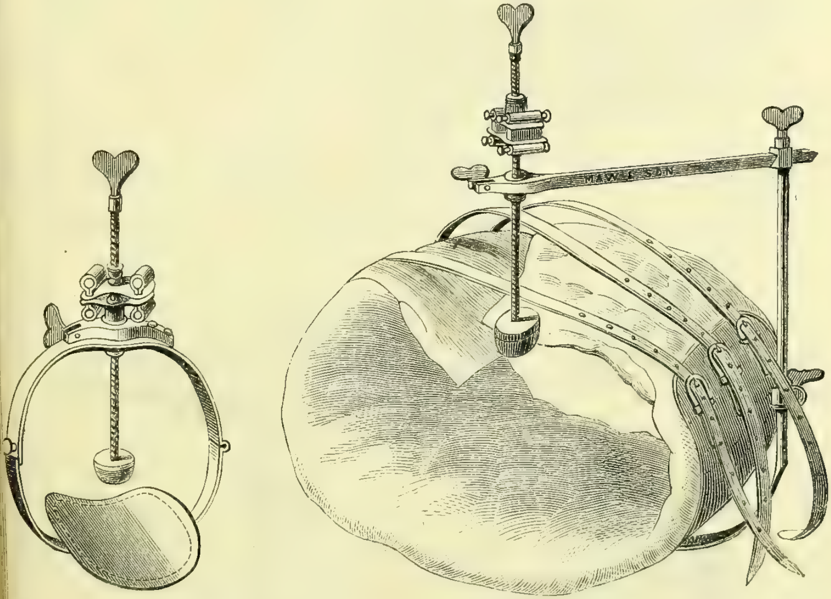


Lister's tourniquet.
(From Maw's Catalogue.)

turn it drags obliquely on the pad, and the artery slips from pressure. If the pad does not exactly fit the limb, a piece of folded lint may be inserted under it. A complete case should be supplied with a compress attached to a handle, for compressing the subclavian artery just above the clavicle or the external iliac as it passes over the pelvis, in cases where the usual tourniquet cannot be applied.

Other forms of tourniquets are here represented. That of Signoroni (Fig. 439) is firm and strong: the only fault proceeds from the fact that as the pressure becomes greater, the direction of the pad becomes more oblique. The late Mr. F. Skey endeavoured to rectify this by constructing a tourniquet (Fig. 440) made of separate and movable pieces of steel. Lister's tourniquet (Fig. 441) was originally devised in order to restrain hæmorrhage from the femoral artery, and from the arteries of the buttock in amputation at the hip-joint. It will be found referred to by its designer in the essay on AMPUTATION.* It has also been successfully employed in controlling the circulation through the abdominal aorta and iliac arteries in the cure of aneurism (vol. iii. p. 614). Carte's tourniquets (Fig. 442) are used in the compression-treatment of aneurism, and have been referred to at vol. iii. p. 490 (note). The larger one is intended to compress the external iliac artery as it passes across the horizontal ramus of the pubes, the smaller for the femoral or brachial artery.

FIG. 442.



Carte's tourniquet. (From Maw's Catalogue.)

The instrument called 'Butcher's saw' merits attention. It consists of a fine steel saw, made of material like watch-spring, but of some breadth, fixed in a steel frame, to which the usual handle is attached. The peculiarity is as follows: the surgeon may turn the cutting edge to any angle he pleases, and may thus saw in a semicircle. In taking off the spine of the tibia after a limb has been amputated, or in rounding off any sharp process of bone, this instrument, which has been constructed chiefly for cases of excision of joints, is most useful. It is likewise an excellent saw for cutting

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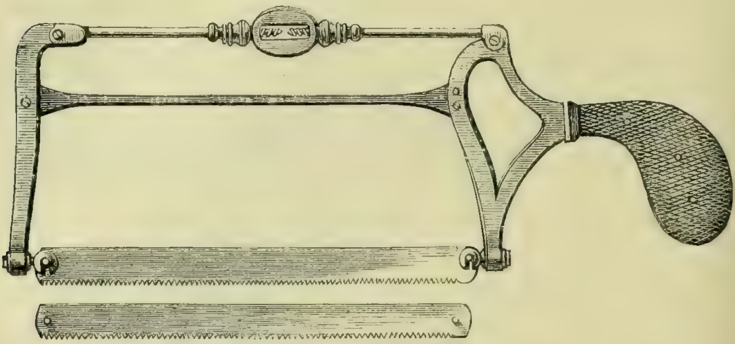
* Where also Mr. Lister refers to the fact that Prof. Pancoast had previously devised a similar tourniquet for the same purpose.

FIG. 443.

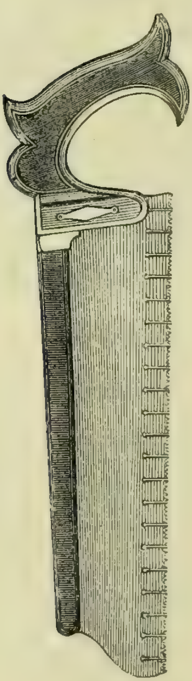


Butcher's Saw. (From Maw's Catalogue.)

through the metacarpal or metatarsal bones in operations on either the hand or foot.

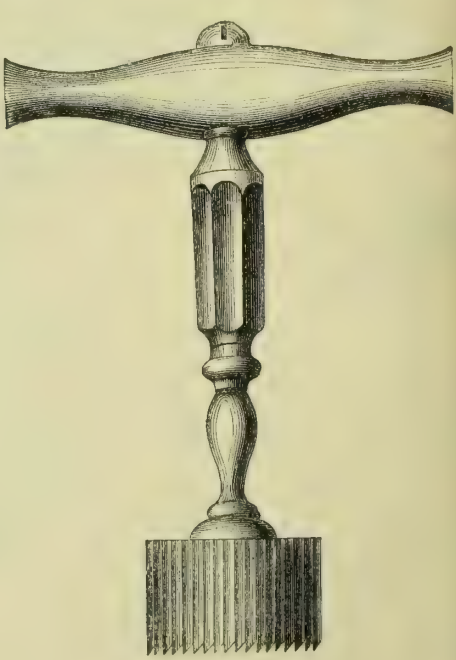
A saw with 'folding back,' called 'Fergusson's saw' (Fig. 444); another with

FIG. 444.



Fergusson's saw.

FIG. 445.



Trephine.

slits in the blade, having the effect of clearing the teeth of the saw during the operation (introduced by the Messrs. Weiss); the bow or frame saw, as common in dissecting apparatus; and the chain saw—have all their merits as applied to particular operations.

Trephine (Fig. 445). Depressed bone may be raised by means of an elevator, and any projecting ridge removed by Hey's saw. The circular saw of the trephine is usually worked upon a centre pin; and when from any cause, such as deficiency of bone, this pin cannot be used, the difficulty which the surgeon experiences in making the saw form a groove for itself on the smooth round skull is very great. A case in which this difficulty was experienced suggested the idea of the construction of a saw worked within a case, which might by pressure be held firmly on the skull for a time by means of three sharp-pointed steel pins.

A very useful modification of the trephine is made by Messrs. Weiss by adding a 'multiplying stock' with rosehead and small trephine saw to the ordinary case of bone instruments. By means of that instrument a thick bone may be expeditiously and safely perforated. A movable collar may also be added to the trephines, by which their action may be regulated; so that when the skull is perforated there is no danger of injury to the brain, as has happened in the practice of more than one eminent operator.

The rosehead is a most effective gouge for removing carious bone, as well as a very convenient instrument for enlarging cloacæ to allow of an exploration for sequestra.

The operation of trephining consists in the perforation of a bone by means of the small cylindrical saw, the trephine, and the removal of the piece of bone so separated.

It is practised on the skull on account of fractures of the bones, 1st, when a portion of bone is depressed and encroaches on the cavity of the skull, producing compression of the brain, and the fragment cannot otherwise be raised; 2ndly, for punctured fractures, by which the inner table is splintered, separated from the outer table, and lying loose on the dura mater; 3rdly, for effusion of blood or of inflammatory products between the bones and membranes, or between the latter and the brain, the result of injuries, when it is presumed that the effused fluid may be evacuated by the opening; and lastly, on account of epilepsy or other affections, when there is reason to believe that the disease depends on a local cause that may thus be removed.

It is an axiom that the operation is not justifiable except as the last resource of surgery in extreme cases, for the operation itself may destroy life.

Again, it is a well-established principle that as little bone as possible should be removed in effecting the object of the operation.

If there is no wound of the scalp, the hair must be closely shaved over an area of two or three inches in diameter; then the soft structures are to be divided down to the pericranium by crucial incisions, so as fully to expose the bone and afford space for the saw. The old surgeons insisted on the pericranium being raised from the bone over the space where the trephine is to be applied. This is unnecessary; but if the operator wishes, he may place the saw on the skull and run his scalpel round it, so as to divide the membrane to the exact extent required. He then prepares the trephine by causing the centre-pin to project about one-eighth of an inch beyond the crown of the instrument, and fixing it in that position by tightening the side-screw. He now places the trephine on the bone, and causes the centre-pin to bore an aperture so as to fix the crown of the trephine till a groove has been cut in which it will work. The sawing is effected by partial rotations of the trephine backwards and forwards, with a light hand. As soon as the groove is deep enough to retain the saw, the centre pin must be raised, as it would otherwise be in danger of wounding the membranes. The rest of the bone is to be divided by very cautiously continuing the operation, examining the groove from time to time by means of a quill cut as an ordinary tooth-pick, so as to ascertain when the thickness of the bone has been reached.

If the saw has cut through in one place, it should be inclined to the opposite side; and, after a few more turns, the circular piece may be raised, probably, by means of the elevator, and the membranes will be exposed. If the object of the operation has been the evacuation of blood, &c., it will be necessary to divide the dura mater and arachnoid, unless they are already opened.

But how can the surgeon satisfy himself that blood or serum has been effused so long as the membranes are entire, and thus justify any further proceedings?

It must be admitted that cases occur in which it is very difficult to decide this question, and experienced surgeons have been at a loss how to solve the problem.

If blood is effused immediately under the dura mater, that membrane appears of a darker colour than ordinary, and may be protruded into the aperture; if serum only is present, the surgeon must be guided by the presence or absence of the protrusion and of the rhythmical motions of the brain. At any rate, in a doubtful case the dura mater should be very cautiously incised, so as to produce as little mischief as possible.

If the operation has for its object the removal of a piece of depressed bone which cannot be raised by the elevator or forceps, and which does not allow of the employment of one of Hey's saws, by which an angular portion might be removed, the surgeon should sacrifice as little as possible of the sound bone. He cannot apply the trephine to the loose fragment, and must therefore so far encroach on the margin of the fracture as to fix the centre-pin on a firm basis.

He will therefore of necessity remove more of the sound bone than of the fragment; but in many cases he may succeed in obtaining space for the elevator without removing the entire circle of bone or without cutting through both tables of the skull; for as soon as the outer one is divided into the diploë, it may be removed by the elevator, and all risk to the membranes may thus be avoided. Still it is better to take away the whole segment than use much force in the elevation of the fragment, as more injury might be done to the brain or membranes.

All loose fragments should be removed; but it has been decided by the highest authorities that splinters of bone or even foreign bodies ought not to be taken away if their removal would produce much bruising or laceration of the brain or of the membranes.

If there is no bleeding, the wound may then be closed by replacing the flaps of integument, and applying lint dipped in water, and a light bandage to afford gentle support. But if there be hæmorrhage it may be allowed to continue so long as it is not producing much impression on the force of the circulation; with this view a piece of wet lint merely laid on the wound will suffice.

Necrosis instruments.—Modern conservative surgery demands the removal of portions of dead bone from the shafts of long bones, and the partial, or total, removal of the short bones when carious, instead of the summary remedy of amputation. The surgeon therefore requires an assortment of instruments for making such passages into the bone-case enclosing a piece of dead bone as will allow of the introduction of forceps, &c. for its removal.

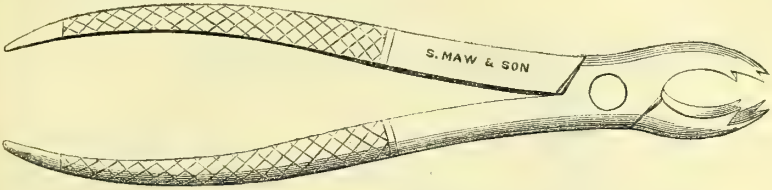
These comprise the trephine and other saws of various sizes, and sets of bone-cutting forceps and chisels, for making or enlarging the apertures, and gouges for excavating the spongy bones.

The cutting forceps should include the ordinary straight ones, a pair curved on the flat and having wide jaws, and others known as angular forceps.

The retaining forceps should be of two or three sizes, one being bent at an obtuse angle, and an elevator should be added.

The 'lion forceps' of Fergusson (Fig. 446) is a most useful instrument in many operations on the bones. It is a strong straight forceps provided with two sets of teeth, set at some distance apart, by which it obtains a firm hold on a bone, and enables the operator to steady it while applying the saw or other means for its removal. In such operations as excision of the superior maxilla, or of one of the bones of the tarsus, it renders the surgeon very effective service, and as a means of fixing a bone in amputation for a compound fracture it is invaluable. Indeed it is applicable whenever the object of the operator is to seize any thing too hard for the employment of the ordinary forceps, as an enchondroma, osteo-fibrous tumour, &c.

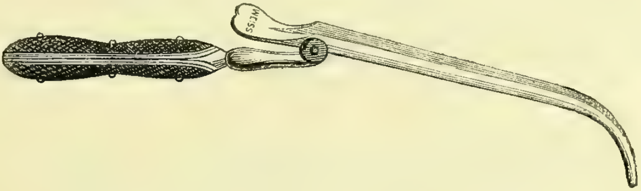
FIG. 446.



Lion forceps. (From Maw's Catalogue.)

The large director mounted on a handle (shown in Fig. 447), is often useful in excising portions of deep seated bones, especially the head of the fermur. The neck of the bone having been sufficiently cleared of the soft parts, the concave side of the director is passed around it. The position of the instrument is then reversed, so as to raise the bone on its convexity, where the groove is, and project it out of the wound, the shaft of the instrument resting on the sound parts, on either side, and protecting them from the saw.

FIG. 447.



The excision director. (From Weiss's Catalogue.)

The *laryngeal canula forceps* (Fig. 448) is an instrument admirably adapted for removing small growths from the interior of the larynx and neighbourhood of the epiglottis. It consists of a bent rod terminating in a pair of small spring forceps, which separate by their own elasticity, and are closed by passing the canula over them. The rod and canula are attached to a handle placed at about a right angle to their axis, and the canula is moved to and fro by means of a ring, through which a finger may be passed. The direction of the forceps may be altered to any angle required, and the curvature may also be increased or lessened as desired, as the canula is made of a flexible material, and the rod jointed to enable it to adapt itself to the curve of the canula. Other forms of laryngeal forceps are figured in vol. ii. p. 492, and vol. iv. p. 586.

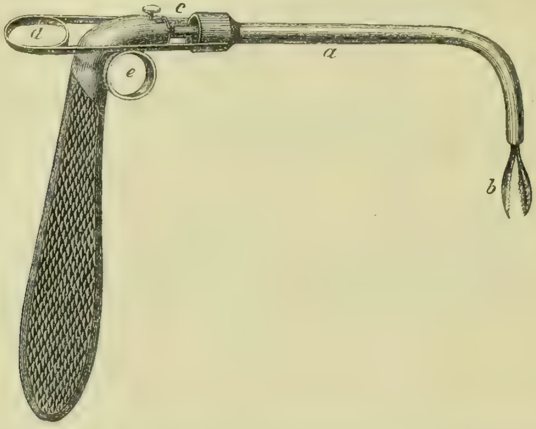
A set of two or three curved canulæ for the trachea is an indispensable addition to the armamentarium of the surgeon.

However the operation of tracheotomy may be done, a canula is required to keep the lips of the wound patent. They are now generally made double, one tube passing into the other, so as to allow of cleansing without the risk of removing the canula altogether from the trachea.

A very useful addition consists in a blunt conical trocar to fit each canula, and assist in passing it into the trachea through a small wound.

There can be no doubt that many of the canulæ to be found in the shops of the instrument-makers are of two small a calibre to allow of the passage to and fro of sufficient air for the purposes of respiration. To obviate this, Dr. Fuller invented a canula consisting of 'a bivalve tube, so made that it may be introduced closed, the blades being expanded by means of a spring as soon as its insertion is effected. The shape of the instrument is such as to readily allow of its admission; its size when opened large enough to permit a free passage of air, and it is so constructed as to prevent obstruction from mucus.*

FIG. 448.



Laryngeal canula forceps. *d*, *e*, rings for the insertion of the thumb and middle finger, holding the forceps; *c*, a button moved by the index finger, and acting on a rod which passes through the stem *a*, and terminates in two blades, *b*. These blades separate by their own elasticity, and are brought to close upon the laryngeal growth by slightly withdrawing the button *c*.

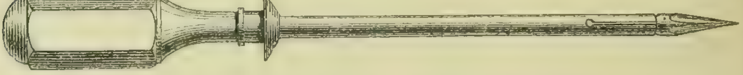
The *laryngoscope* has been fully described at vol. iv. p. 514, et sqq.

Two or three pairs of curved forceps are required for removing foreign bodies that have become fixed in the fauces or pharynx. The forceps are made to open from side to side, or from front to back, so as to enable the surgeon to seize any substance placed across this passage.

The probang is necessary to push down into the stomach any foreign body that can be safely and expeditiously removed by it.

The stomach-pump, to which may be appended an enema apparatus, must also be at hand. The self-acting instrument made by Weiss, which requires but a turn of the valve for alternating its action, is probably the simplest and most useful one in operation. If the surgeon wishes, he may have it made to fit his catheters, and can also have nozzles adapted for injecting the meatus of the ear, &c.

FIG. 449.



Trocar for puncturing the bladder. (From Maw's Catalogue.)

A set of elastic œsophagus bougies is necessary for the treatment of strictures in that canal.

Trocars and canulæ, of which some may be graduated, are used for paracentesis of the chest, abdomen and bladder, or for tapping hydroceles. Those suited for puncturing the bladder above the pubes, and through the rectum are here represented (Figs. 449, 450). The canulæ may be adapted to a brass syringe, or to the stomach-pump, for injecting fluids into the cavity of a hydrocele or cyst.

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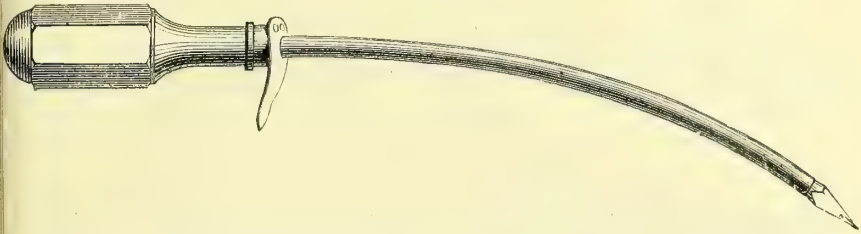
* Vide INJURIES OF THE NECK, vol. ii. pp. 509–511.

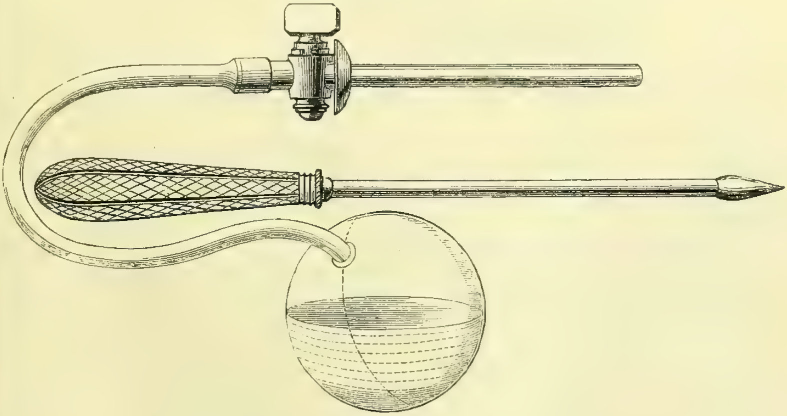
The trocars and canulæ of Thompson and Wells, for excluding air while used in the evacuation of fluids from the chest and abdomen, are well adapted for their purpose (Fig. 451). They consist of canulæ to which elastic tubes are joined for carrying away the fluids, and of contrivances by which the trocars may be withdrawn beyond the junction of the elastic tubes, without permitting the entrance of air into the canulæ. The tubes may be filled with water to exclude air from the apparatus entirely, and when in operation the lower end of the tubes should dip into the fluid. By means of them the pleural cavity, peritoneal sac, or an ovarian cyst, may be tapped without the risk of admitting air into those cavities; or they may be used in opening a large lumbar or psoas abscess, or a distended joint.

Fig. 450.



Trocar for puncturing the bladder through the rectum. (From Maw's Catalogue.)

Fig. 451.



Trocar for paracentesis thoracis. (From Maw's Catalogue.

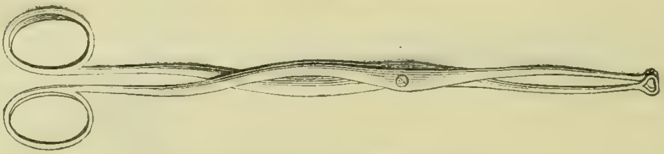
An ingenious exhausting syringe adapted to a fine trocar has been lately introduced by Dr. Dieulafoy, and is referred to in the essay on Diseases of the Urinary Organs, vol. iv. p. 994. Instruments for effecting the same object have also been invented by other surgeons.

For examining the rectum and vagina one or more of the various kinds of tubular specula is necessary. Those that expand gradually by means of a screw attached to the handle of the instrument are very convenient for operations within the vagina. The smooth conical metal ones are suitable for the rectum.

For the operations in the rectum, the surgeon must have a set of bougies for dilating strictures; forceps or hooks for drawing down hæmorrhoids, and strong scissors or shears for excising them. Two or three needles, having their eyes near the points, and set in handles, as used for applying ligatures to nævi, are very useful in operations in the rectum.

The forceps (Fig. 452) are useful in seizing and holding hæmorrhoidal excrescences. Curling's clamp (Fig. 453) and Smith's clamp (figured in vol. iv. p. 807) merit praise for the objects they profess to attain, namely, holding hæmorrhoidal and other growths, and preventing hæmorrhage.

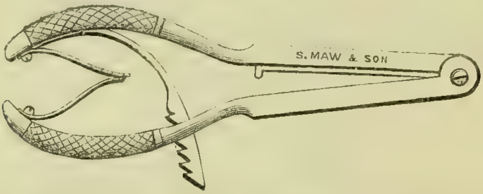
Fig. 452.



Pile-forceps. (From Maw's Catalogue.)

No instruments are of more importance to the surgeon than those used in operations on the urethra and bladder. They are of infinite variety—the products of the ingenuity of many of the greatest operators of all times. To enumerate them would require much time and space; such only as are adopted by surgeons generally will be noticed here, without any disparagement to others.

Fig. 453.



Curling's clamp. (From Maw's Catalogue.)

In the first place, a good set of about eight or ten silver catheters, having wooden handles, as recommended by the late Sir Benjamin Brodie, should be in the possession of every surgeon. One or two small ones for children are also very often required. A very long one, having a large curve, may be needed for cases of enlarged prostrate gland; a double-way catheter for injecting the bladder; and one, opening at the extremity, and fitted with a flexible metal piston for use when the bladder contains blood-clots, is very serviceable.

In addition to these, the surgeon should have a dozen elastic catheters, in graduated series, fitted with wire stilettes, and a few straight solid bougies.

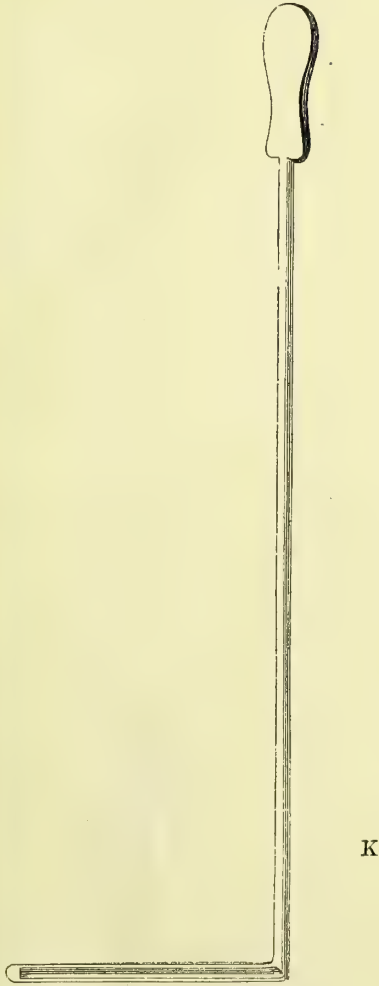
For tapping the bladder per rectum, he requires the curved vesical trocar and canula (Fig. 450). All these instruments should fit one or more nozzles of a syringe, and a set of soft-wood conical plugs should be kept to close them when required.

The surgeon will often find it very convenient to be provided with a small bottle of oil in his catheter-case.

A set of smooth steel sounds, shaped as ordinary catheters, enables the surgeon to treat some strictures that are otherwise very troublesome to manage.

Modern surgeons especially have contrived various instruments for the treatment of refractory strictures of the urethra on other principles than that of gradual dilatation. Amongst them are the urethrotomes of Fergusson, Thompson, Syme, Stafford, Wood, &c., for dividing portions of the urethra; and the

FIG. 454.



Buchanan's rectangular lithotomy staff.
(From Maw's Catalogue.)

FIG. 455.

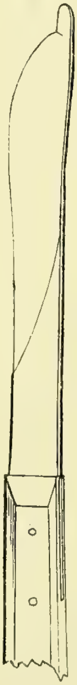


FIG. 456.

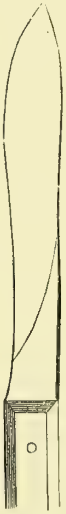
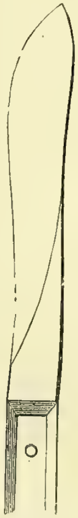


FIG. 457.

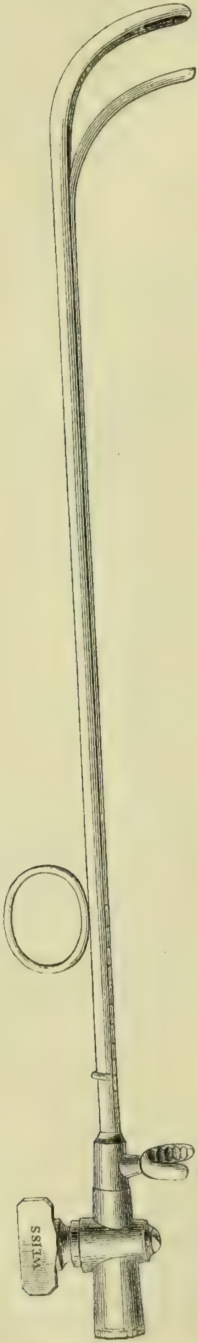


Key's knife. Liston's knife. Brodie's knife.
(From Maw's Catalogue.)

dilators of Holt, Wakley, &c., for distending strictures. No doubt all these instruments, in careful hands, fulfil the purposes for which they were intended; but they require skill and judgment in their employment.

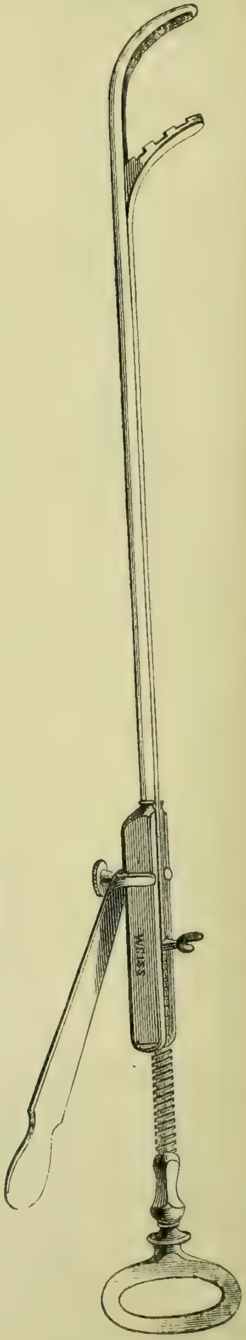
For exploring the bladder in search of stone, &c., the surgeon requires a set of steel sounds of various sizes and curves. They should be well polished, and have smooth handles; their extremities should be round and smooth. Then for incising the urethra a set of grooved staffs is essential. Some surgeons have them grooved at one side; others on their convex surface. Some use them of

Fig. 458.



Weiss's catheter scoop.

Fig. 459.



Brodie's lithotrite.

(From Weiss's Catalogue.)

abrupt curves, some of gradual, and others straight. It is well to have an abrupt stop in the groove near the end of the staff, and the groove itself should be as deep as possible.

Some surgeons employ the rectangular staffs of Buchanan (Fig. 454) and Hutchinson in lithotomy. The knives used by the great operators of our time, (Figs. 455 to 457) are somewhat varied; but may be styled, in general terms, long-handled scalpels for cutting into the urethra, and beaked knives for incising the prostate.

Surgeons seem still divided in opinion as to whether a lithotomy knife should or should not be 'beaked.' Perhaps the latter is the safer. But if the operator can rely on his hand that the knife shall not leave the groove of the staff, the shape suggested by Liston is the most handy. These points, however, have been discussed in the article on lithotomy.

For the removal of stone from the bladder, forceps of many shapes and sizes are required to meet all the exigencies of practice. Probably few experienced surgeons would be content with the choice of less than a dozen pairs; and occasionally nothing but the spoon-scoop will enable the operator to extract a stone or fragments of one; therefore one or two should be kept.

Sometimes a scoop curved laterally on its handle will prove a very convenient instrument for reaching a stone behind the prostate. This instrument is much recommended by Sir H. Thompson.

Fig. 458 represents Weiss's catheter scoop, which was originally made on the suggestion of Sir H. Thompson for injecting and removing the *débris* of calculi from the bladder, and which, by the addition of the stopcock, is also made useful for measuring the size of the stone and for sounding.

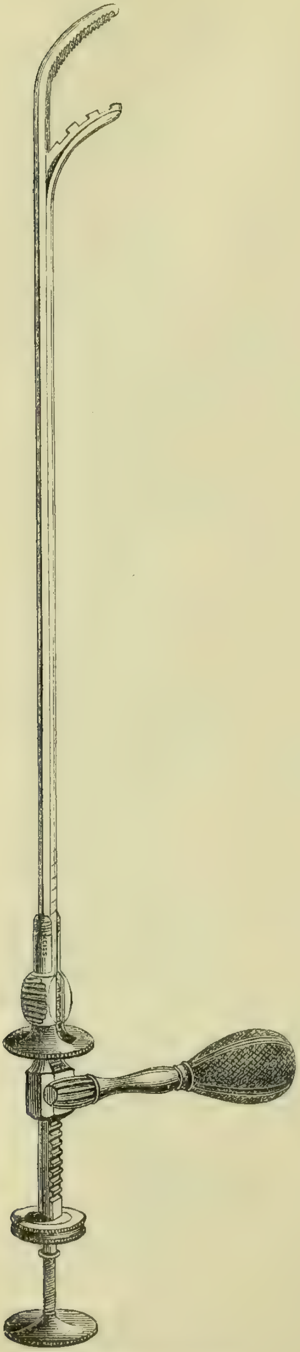
Figs. 459 to 462 show some of the forms of lithotrite in ordinary use. Fig. 459 is the one known as 'Brodie's,' in which the male and female blades are moved on each other by a button, and the stone crushed by the screw in the stem. The instrument is provided with a handle which can be removed at pleasure. Fig. 460 shows one of the forms of the rack and pinion lithotrite, which is called 'Fergusson's;' the instrument is represented with a handle, which, however, is no part of the apparatus, but is merely added in order to steady it in the operator's hand, and can be removed at pleasure. The blades are disengaged from each other by pressing either upon a trigger or button close to the handle, and similarly brought again into gear, when they are pressed down upon the stone by screwing the nut at the top of the instrument. Fig. 461 shows another and very convenient form of rack and pinion lithotrite, known as 'Civiale's.' When the two upper nuts marked A correspond to those marked B, the blades are movable on each other; when the stone is found, the blades are at once brought into gear by bringing the two nuts A perpendicular to those marked B, and then the blades are screwed home by the handle C.

The improved lithotrite of Weiss (Fig. 462) leaves little or nothing to be desired as a means for crushing a stone in the bladder. It is divested of the awkward handle of former instruments, and has in its place a short cylinder, which, being placed on the axis of the instrument, forms a convenient hold for the operator. It can be worked by means of its screw, or as a percussion lithotrite. The screw is fixed or disengaged in a moment by sliding a button (A) along the cylinder, or simply by pressing it with the finger, without communicating any motion to the sliding portion of the instrument. The male blade is pushed home by turning the screw on the end of the lithotrite. There can be no doubt that the motion of the screw is much better adapted for the purpose than that of the rack and pinion. The instrument has also the great advantage of being easily taken to pieces, cleaned, and re-adjusted; and such portions as are liable to rust are silver-plated.

Powerful lithotrites have been invented for breaking a stone which is too large to allow of its extraction by the wound made in the ordinary operation of lithotomy, but are seldom used or needed.

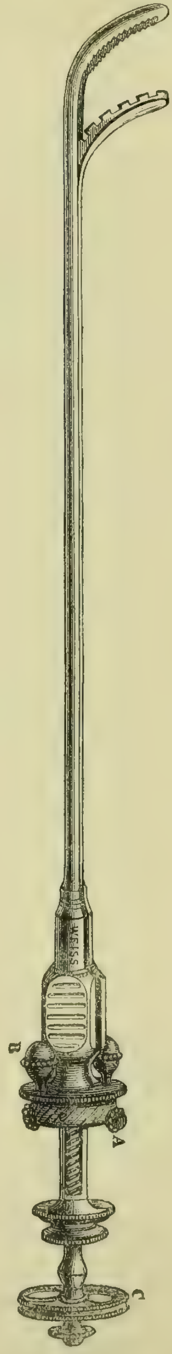
In addition to the instruments above enumerated, the surgeon may require some means of removing a small calculus that has become impacted in the urethra. For this purpose a long slender straight forceps has been contrived.

Fig. 460.



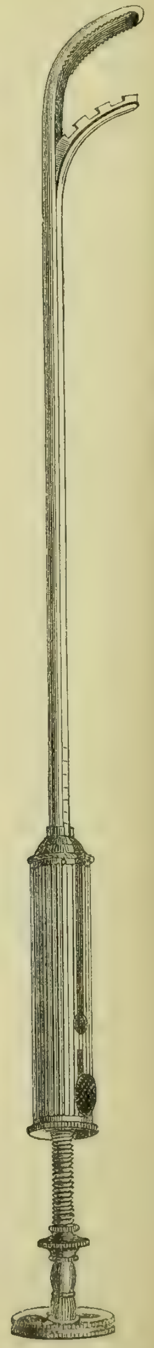
Fergusson's lithotrite.

Fig. 461.



Civiale's lithotrite.

Fig. 462.



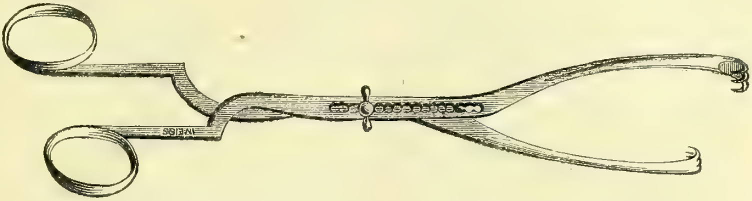
Weiss's lithotrite.

(From Weiss's Catalogue.)

A forceps closed by means of a canula is also well adapted for the same purpose.

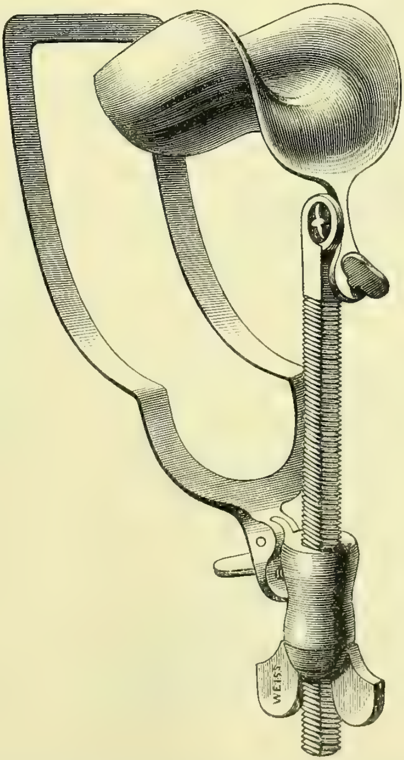
Uterine instruments.—Most of the instruments used by surgeons in operations on the female genital organs have been already spoken of in the essay on the Surgical Diseases of Women. We shall here only figure two ingenious instruments devised by Messrs. Weiss, and which occasionally prove serviceable in the more complicated operations. Fig. 463 shows a pair of hooked forceps,

Fig. 463.



Sliding valsellum forceps for tumours, especially those of the uterus. (From Weiss's Catalogue.)

Fig. 464.



Self-supporting speculum—devised by Messrs. Weiss—for operations on the female genital organs in which it is convenient to dispense with the aid of an assistant.

the blades of which being separable from each other, can be fixed into any accessible parts of the tumour, and connected by means of the screw at any part corresponding to the notches shown in the figure—securing a grasp of a tumour of almost any form, the consistence of which is sufficient to afford a hold to the hooks. Fig. 464 shows an apparatus for fixing a speculum in the lower wall of the vagina, and thus dispensing with the services of an assistant, or sparing his labour in a protracted operation, as for vesicovaginal fistula. The speculum is fixed at any angle which may be found convenient into an upright stem, to which is attached, at a proper height, regulated by a screw, a frame which is padded with a napkin and adapted to the sacrum. The instrument, having been properly adjusted, will keep its own position.

Eye instruments.—These may be classed under two heads: 1st, instruments employed in diagnosis; 2nd, operative instruments.

Under the first head must be mentioned that most essential instrument, the ophthalmoscope. Though very many forms of this instrument are employed by surgeons, two or three only need be noticed here. For all ordinary purposes, the ophthalmoscopes of Liebreich, Coccius, and Zehender are recommended. They are very portable, of small cost, and of simple construction, and are, further, of easy application. With any one of these the eye may be effectively explored; but the two first named are more suitable for the indirect mode of examination, and the latter for the direct.

The large fixed instrument of Liebreich (Fig. 465) is well adapted for class purposes, or for taking drawings. Small ophthalmoscopes that may be carried in the waistcoat-pocket are very convenient, and likely to be at hand when required. At the writer's suggestion, the mirror has been mounted as an ordinary pocket lens, and occupies less space than a watch (Fig. 466); and, being made of glass, it is less likely to become tarnished than metallic specula. The binocular ophthalmoscopes of Giraud-Teulon and Laurence afford beautiful views of the interior of the eye; and as the observer is enabled to use both his eyes at once, he sees with less light, and can minutely scrutinise the details of the stereoscopic image without sense of fatigue, and can judge more accurately of relief and depth than when using only one eye.

For side-illumination of the eyeball, two ordinary lenses, of about two-inches focus, are required. A good oil- or gas-lamp is also essential.

For the subjective examination of the eye, the surgeon should have two sets of spherical lenses, of foci varying from two inches to 80 inches; one set being convex, the other concave. A series of cylindrical lenses is also required for the investigation of astigmatism; and also a stenopæic apparatus. For examining cases of paralysis of the muscles of the eye, a series of prisms should be provided.

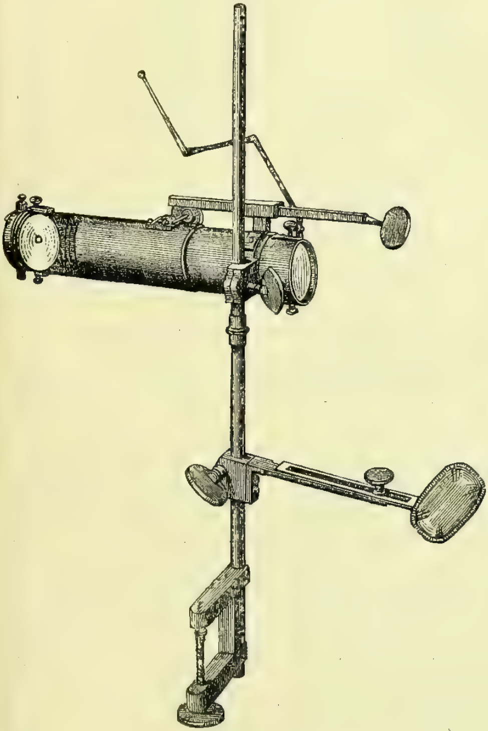
Then, as test-objects for ascertaining the acuteness of vision, and for future comparison, the scale of type invented by Snellen is an invaluable aid. It has been recently adopted by the Government as a standard.

The instruments required for the ordinary operations performed on the eye at the present date consist of the usual cataract-knife, or that of Beer modified by Sichel, &c.; the sharp hook for lacerating the lens-capsule; Daviel's spoon; a bistoury for enlarging sections of cornea, or scissors; Jäger's cornea-knives, straight and bent; iris-forceps and Tyrrell's blunt hook; curved iris-scissors, Schuft's spoons or Critchett's extractor, Lüer's forceps and scissors, forceps for fixing the eye, strabismus scissors and hook, cilia-forceps, needle-holder, suture-needles, entropium-forceps, spring-wire speculum for holding the eyelids, set of probes for lachrymal canals and nasal duct, director for opening the punctum, cautery-needle, broad cutting-needles, and two of Dalrymple's needles. The needles may be very conveniently fixed in two handles and slide as in a pencil-case. Tyrrell's iris-hook should be made of silver or platinum, so that it may be bent as required.

Many other instruments adapted to special purposes are used by ophthalmic surgeons, which, though not absolutely indispensable, yet are of so frequent application that they deserve to be noticed in this enumeration of eye-instruments.

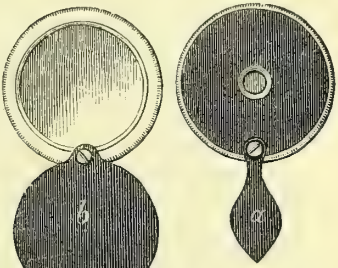
Such are the 'stopped' needles of Bowman, which are provided with shoulders to prevent their passing too deeply into the eye, while both are being used at the same time—as in lacerating a membrane which occludes the pupil; the canula-lancet of Bowman for strictures of the lachrymal canals; Hulke's needle (set in a handle), for inserting sutures in the conjunctiva; Snellen's forceps for the eyelids, to restrain bleeding while operating for entropium, &c.; an ivory spatula for raising the lids and protecting the eyeball while applying the actual cautery, &c.; Dixon's little spatula, to replace the iris when prolapsed; Desmarre's elevators, for the eyelids; Streatfeild's forceps for fixing the eye; fine scissors for enlarging the lachrymal punctum; White Cooper's curved forceps, for Lüer's canula instrument; Critchett's bent cutting-neddle, for making a small aperture in the cornea; the 'suction-curette' of Mr. Teale, jun. and those of Mr. Bowman and Dr. Bader, for the removal of cataracts of such consistence that they may be thus removed through a small aperture.

Fig. 465.



Liebreich's ophthalmoscope.

Fig. 466.



Pocket ophthalmoscope.

Almost all these instruments are delineated in the illustrated catalogues of surgical instruments published by Weiss and Maw, in the *Atlas chirur. Instrumente und physikalischer Apparate für Aerzte,* by Leiter, Vienna, 1863; and in Dr. Cessner's work, *Chirurgische Instrumente,* Vienna, 1863; to all of which the writer has been indebted for some of the descriptions of the instruments as well as for the figures.

Fracture-apparatus.—The appliances invented for the treatment of fractures of the bones are almost innumerable; so much so, that a bare enumeration of them would fill a goodly volume.

It would, therefore, be out of place to attempt to do justice to the different apparatus in these pages; but some are of such importance that some allusion must be made to them in a systematic work on surgery; and though we cannot afford space to mention others, we are not insensible to their value.

Mr. Luke's fracture-bed is one of the most useful that has been contrived, and as it is not so well known as it deserves, we shall give a short description of it.

It consists of a light wooden bedstead, on which the mattress is placed, and of a frame to which a canvas stretcher is fixed, having an aperture about its centre of about eight or ten inches diameter; on this the bedclothes are laid and the stretcher lies between them and the mattress. The frame is attached to the bedstead by two iron bands on each side, so as to allow of a similar motion to that of the 'parallel ruler.' A curved iron arm, carrying a windlass and leather-band, slides into an aperture in the end of the bedstead, and when out of use may be removed; to the free end of the strap is fixed a hook, and on the end of the frame an eye, to correspond when required for a patient. Two small blankets should be folded on the stretcher so as to allow of their being separated opposite the aperture in the canvas, and two sheets should be folded in the same way; the patient, being placed on them, may then be covered with the upper bedclothes as in an ordinary bed. To raise him while using the bedpan, the curved arm is to be fixed to the bottom of the bedstead, the strap hooked on the frame; and on turning the windlass he will be gently raised from the mattress, and may be retained in that position as long as necessary; the bedclothes are then separated over the aperture, and the bedpan placed under the stretcher; he may then be gradually lowered upon the mattress, the windlass removed, and the apparatus remains as an ordinary bed.

In cases of fracture or other injury of the spine, or of the femur, &c., this elevating bedstead is invaluable, as it avoids all necessity of moving from day to day.

Earle's or Amesbury's fracture-bed is provided with three inclined planes for the patient's body, thighs, and legs, which are so arranged that the angles which they form with each other may be altered at pleasure, and therefore enable the surgeon to flex the thighs on the pelvis, or the legs on the thighs, as he requires. The planes should also admit of lengthening or shortening, as a case may demand.

This bed is thought of service in the treatment of fractures of the neck and upper portion of the shaft of the femur. Some surgeons employ it also in fractures of the middle and lower thirds, and in fractures of the tibia and fibula attended with tilting of the ends of the bones. But the same ends are usually now attained by simple means.

Liston's thigh-splint is described at p. 615, vol. ii.

Skipton's splint is described at p. 629, vol. ii.

Lonsdale's apparatus for fracture of the patella is described at p. 624, vol. ii.

Salter's 'swing' for fractures of the leg is described at p. 630, vol. ii.

The hydrostatic bed of Dr. Arnott is one of the most valuable inventions of modern times, and is almost indispensable in the treatment of patients long bedridden, and disposed to ulceration or mortification from continued pressure. It consists of an oblong trough partially filled with water, and covered with Mackintosh cloth securely fixed to the top of the trough, but floating loosely on the surface of the water, so as to allow the patient to lie equably supported by partial displacement of the water.

The same purpose is attained in a less degree by means of mattresses or cushions made of impervious cloth, so as to contain water. But as the water-bed and mattress are very expensive, and unless treated with great care will be soon destroyed, they have been to a great extent superseded by bedsteads having spiral wire-springs to afford the desired elasticity, or bands with rings of caoutchouc attached to their extremities. The latter are very effective, and allow of easy adjustment by placing the bands and rings as required.

Spinal curvature.—For the treatment of this deformity two kinds of apparatus may be employed: first, that which is intended to keep a weak spine straight, or to prevent an increase of curvature in its early stages; secondly, that which professes to press back displaced vertebræ by acting, by means of a pad, on the ribs.

The first is made by adding side steel crutches to the common French stay, which is laced up from behind, and closed in front by metal eyelet-holes. These stays should be fitted to the patient very much too tight for ordinary use. Next, the surgeon marks by a pencil the exact situation which the side steel crutch should occupy. By means of a long piece of lead he takes an exact impression of the form, and by such means the steel crutch can be moulded and fitted on within the stay on either side.

To this may be added a steel plate to press on the convexity of the curve, or numerous steels of small size to give strength where it is required. Such an apparatus, carefully made and constantly worn, will, with due care, prevent the sinking of the spine and the attendant visceral displacements.

The second variety of apparatus is intended to correct an established spinal curvature. Under all circumstances the principle is the same, being a modification of 'Tavernier's belt.' A padded steel belt goes round the pelvis; steel crutches extend thence on either side to the axillæ; a webbing-strap passes across the chest; and a pad, moved by a cogwheel, acts on the convexity of the curve. If there be two curves, two movable pads are requisite. Cogwheels are attached to the side crutches.

This is the apparatus of which it is said an almost daily attendance on the part of the surgeon is necessary to effect a cure by means of cogwheels and screws.

If we divest the subject of charlatanism, we must confess that a patient, the subject of progressive curvature, may derive much benefit from carefully-applied and slowly increasing pressure, such as may be obtained by the use of this instrument. When once the vertebræ have become altered in shape and thinned towards the concavity of the curve, no complete cure can be effected. But in a very great number of cases the patient's condition may be greatly ameliorated.

Nearly every practitioner of this branch of the profession has affixed his name to some apparatus or another; they are in most points similar.

Contracted cicatrix.—The treatment by slow extension and by direct pressure of deformities, caused by the contraction of large cicatrices after burns, or other causes of extensive destruction of the integument, is a subject meriting attention. The apparatus used to straighten a contracted limb is similar to that already described as applicable to cases of contraction after disease of the articulation; that employed to stretch the contracted integument of the neck is a variety of the spinal apparatus with a movable piece of padded steel, worked with a screw, and passing round the head. The principle is in all instances the same—the very slow and gentle application of the extending power. If the skin cracks, the apparatus must be removed until the wound is closed; and during the period of healing, the parts inevitably become recontracted. After a sufficiently protracted course of treatment, the extended cicatrix loses its disposition to gather up in puckered folds.

Direct pressure is also useful in certain cases: it renders a hardened cicatrix soft and pliant. It may be effected by the use of metal plates, of leather, or of gutta-percha bound carefully on the affected part.

All such methods are preferable to the use of the knife.

Contracted joints.—The extension of limbs contracted after disease of joints is effected by a well-padded apparatus worked by a cogwheel. All the plates of metal surrounding the limb should be broad, that the pressure may not cut into the flesh. If the patient is able to move about, a boot may be attached to the irons. If he be confined to bed, a thin slipper with a metal sole is more appropriate. The movements at the joint should resemble the natural movements of the limb: thus, at the elbow and the knee, the simple movement of extension and flexion will suffice; while at the hip there will be needed the movements of flexion and extension, abduction and adduction; also rotation. For each of these a special screw is requisite; and the whole apparatus must be attached to the body by a pelvic band.

Artificial limbs.—The manufacture of artificial limbs is a subject of the deepest interest to both patients and surgeons; and sufficient attention has not yet been given to the labours and intelligent researches of those gentlemen who have devoted their minds to this important subject. It is true that the further the amputation is performed from the trunk, the less the chance of death, but there are many other points, even supposing the wound to be healed, which merit more careful enquiry. Between the old wooden leg and the present artificial limb the difference is immense, and the point now to be obtained is the co-aptation of the surgical operation with the means afforded of mechanical relief to the patient.

Among the earliest and most earnest of workers in this mechanical branch of surgery stands Mr. William Robert Grossmith. For nearly a century he and his successors have carried on their honourable calling.

In a pamphlet published in 1857, it is explained that the term 'cork legs' means that the framework of the English legs has always been constructed in wood, cork being used for the external shaping. The first improvement consisted in the substitution of wooden sockets, fitted to the stump, and a very light frame of wood covered with cork for the lower part of the limb, in lieu of the heavy steel uprights and coverings of thick leather used elsewhere.

An artificial limb must be always made of wood; the finest productions in steel will not bear the constant wear and the effects of changes in climate; extreme lightness must be combined with extreme durability, and then the greatest possible amount of movement must be obtained. Mr. Sleath was the inventor of the kneeling artificial leg; also the invaluable 'locking joint' to the common wooden leg; and he enjoyed a high reputation till his death, when he was succeeded by Mr. Williamson, who, finding that spiral springs were apt to break, devised a new principle. The exterior form of the limb was worked entirely of willow, which he found was equally light in weight, and far more lasting than a mixture of cork and wood; it was also much easier to be shaped, with anatomical exactness, to the model of the living limb it had to represent. Then, to get rid of the clumsy 'patella strap,' he reversed the action of the joint, and by making a circular chamber in the anterior part of it, and passing a steel pin through the posterior, he was enabled to make a perfect stop admitting of easy regulation.

It has been rightly observed by Mr. Gray that amputation having been performed, the work of the operator is over; that it is rarely considered within his province to attend to the construction of the artificial substitute, and here the services of the members of the mechanical department of the profession may be said to commence.

It must be remembered that in no case where the operation is made through the leg or thigh, can the person rest easily the end of the stump upon the artificial support. It is only where a part of the sole of the foot is made to cover the bone that the end of the truncated limb will sustain, without pain or injury, the weight of the body. It is likewise to be borne in mind, that the greater the length of the limb that remains after amputation, the greater will be the ease, steadiness, and the power in commanding the artificial support, and the greater therefore the facility of progression.* Amputations of the leg should not be performed on children, but the lower third of the thigh unhesitatingly selected, for this very important reason, that the amputated limb ceases to grow in uniformity with its fellow, and the patient is doomed to the additional inconvenience of having one knee-joint elevated perhaps some inches above the other, and imparting to his gait a peculiarly grotesque appearance.†

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* Gray, *Automatic Mechanics*, p. 46.

† *Lancet*, February 14, 1854.

The usual 'wooden leg,' (Fig. 467), suited for working persons, is composed of the bucket, to which is attached the 'pin,' to ensure connection between i and the ground.

The most eligible stump for the adaptation of an artificial leg, below the knee, is obtained by amputation at the lower third of the leg. The same remark applies to the thigh, the lower third, when possible, being the most convenient situation—the conical form of the stump being best adapted to fit the socket or bucket of the artificial leg.

The common wooden leg is best suited to a poor man: artificial limbs require an annual outlay and expenditure to keep them in repair, because, owing to the friction, both the joint and the tendons get loose.

Fig. 467.

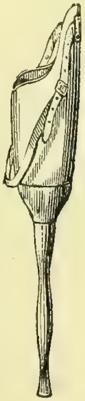


Fig. 468.

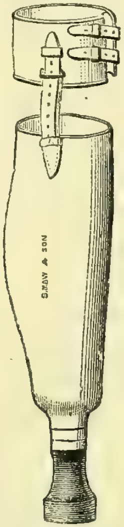
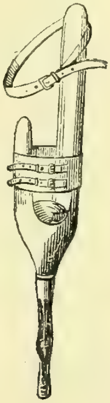


Fig. 469.



Wooden legs (from Maw's Catalogue). Fig. 467 is the common bucket-leg. Fig. 468 represents a rough kind of artificial leg for cases of amputation at the lower third of the thigh. A foot properly constructed would add to the appearance of the limb. Fig. 469 is the usual limb for cases of amputation at the upper part of the tibia, when the patient bears upon the knee.

Amputations of the foot and ankle, such as those known by the names of Chopart, Syme, &c., when properly performed, and in cases where there is plenty of integument to enable the patient to bear the weight of his body on the end of the stump, require nothing but a common boot, the front part filled with cork, and in some cases provided with lateral steel supports inserted between the linings of the boot.

If the converse prove to be the case, and the patient cannot bear his weight on the end of the stump, then a leg has to be 'built up,' the bearings being from below the knee, leaving the end of the stump free. These cases are always unsatisfactory, as the bulbous extremity of the stump gives the leg a very ugly appearance. As many of these operations, Syme's, Pirogoff's and others, are unsuccessful in these respects, it is a question whether amputation at the lower third of the leg is not the more desirable operation. All artificial limbs, whether cases of amputation above or below the knee, are made of wood, with the socket accurately adjusted to fit the circumference of the limb, the end of the stump being left free. They have lateral steel joints for flexion; but stopped in front to prevent the falling backwards of the limb. Behind are tendons or springs, to represent the tendo achillis, and the same in front to represent the elevations of the foot. The patient in walking throws the limb backwards, thus making pressure on the substitute for the os calcis and causing the toes to point downwards.

In the artificial leg for operations above the knee, there is a prolongation of the back tendon (A), so that it is united with cords representing the hamstring tendons.

Fig. 470.

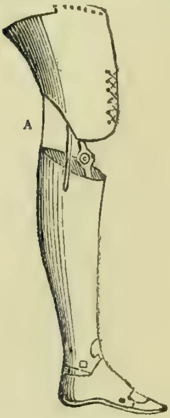
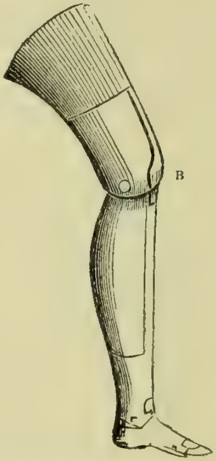


Fig. 471.



Artificial limbs (from Maw's Catalogue). Fig. 471 represents a limb with the knee strap (B).

Artificial limbs may be arranged as follows. Socket or bucket legs for amputations immediately above joints, kneeling legs for amputations below joints. Boots for ankle and heel operations.

These have to be modified to suit particular cases, such as amputation at the knee-joint, very short stumps at the hip. But artificial limbs are rarely of much use in cases of amputation immediately below the hip-joint, where the stump is very short.

Special avocations, such as shoemaking, or tailoring, sometimes require a joint with a 'fluke leg-catch.'

There are many notices from advertisers of limbs, respecting patent acting joints, which are for the most part modifications of the principles enunciated above. Some foreign limbs, of considerable merit and ingenuity, have been exhibited from time to time, but into these matters it is not proposed to enter. I have to thank Mr. Fergusson of Giltspur Street for kindly supplying me with many points of information on the subject.

In the construction of an artificial arm, says Mr. Heather Bigg, the necessity of creating a surface that shall receive the weight of the body is altogether unneeded, the object to be attained consisting more in delicacy of action, and perfection of external appearance, than anything assisting bodily locomotion.*

Amputations of the upper extremity, as well as those of the lower extremity, are not always operations of selection, but I would again point out that the surgeon and the mechanician do not always agree upon the best place for dividing the bone.

Amputations at the wrist-joint leave a bulbous stump, to which it is not easy to attach an artificial hand; but when the operation is performed at the lower third of the arm, a convenient apparatus can be readily adapted to a well-covered conical stump. The preservation of the elbow-joint is of an importance equal, if not greater, than the preservation of the knee, for apparatus may in such cases be adopted, which, though expensive, will give the patient the movement of the fore-arm and hand.

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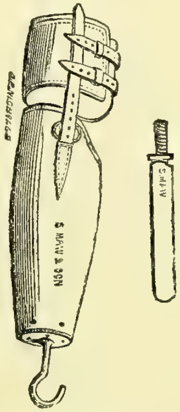
* Bigg on Artificial Limbs, p. 47.

Above the elbow, the lower third of the arm is the preferable point, provided there be ample supply of integument to cover the stump. Amputations at the shoulder-joint require special consideration.

The simplest form of artificial limb, in cases of amputation of the arm above the elbow, consists of a leathern sheath accurately fitted to the superior extremity of the stump. To the limb, which may be bent, is adapted a wooden block and metal screw-plate capable of holding a fork, hook or knife.

An improvement on the above is effected by a limb admitting movements at the elbow communicable at the will of the patient, and produced by a ratchet and cog-wheel connected with its centre. The action is limited by a small spring button placed on the inner side of the arm, just above the elbow.

Fig. 472.



Artificial Arm. (From Maw's Catalogue.)

A foreign apparatus, the plans of which are, I believe, in the possession of Mr. Gray, has been constructed, though not yet perfected in this country, by which the movements of the sound limb are transmitted by means of strings to the artificial limb. In cases where expense is no object, such an invention may merit enquiry.

An artificial limb below the elbow is simple in construction. A well-fitting leather sheath must be adapted to the stump. To this is attached a wooden block and screw-plate; while two broad lateral straps extend to a padded band placed round the upper arm.

HOLMES COOTE.

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[*The words in capital letters are the titles of essays; when no number of volume precedes the number of the page, the matter will be found in the volume last referred to.*]

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